Observations on the Tuberculo - opsonic Indices and the Opsonic Indices to Bacillus Coli Communis, Staphylococcus Aureus and Micrococcus Rheumaticus of Six Control, and Thirty Insane Persons, with Clinical Results following the Injection of Tuberculin.

by

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INTRODUCTION.

Death rate statistics of persons dying in large institutions are often inexact, as their correctness depends, to a very large extent, on the personal factor of their compiler.

Unfortunately, the statistics of the death-rate from tubercular disease, particularly phthisis, occurring in asylums leave no room for doubt that the insane, as a class, are particularly liable to contract tubercular disease.

The English Lunacy Commissioners, in their report for 1902 say "The proclivity of the insane, whether confined in Asylums or not, to tubercular disease, especially pulmonary, has long been recognised."

In all asylums, according to Clouston, who was amongst the first to draw attention to the fact, comsumption is between three and four times more common than in the general population at the same ages.

There is, however, great differences of opinion, as to whether this high tubercular death-rate is due to the fact that the insane are herded together in asylums or whether the insane, as a class, have an abnormally low resistive power to the invasion of the tubercle bacillus.

Clouston/

Clouston says that four fifths of the insane dying of phthisis, contract the disease after admission to asylums. Another observer has stated that not more than 7.5 per cent of cases admitted into asylums are phthisical, and in 10 per cent a family tendency exists.

In English asylums, about 15.5 per cent of deaths are officially assigned to phthisis, and in at least 20 per cent, signs of tubercular deposit in the lungs may be traced.

The average duration of residence of those dying from this cause in Scottish asylums is 3.66 years. It is therefore probable that, in many cases, phthisis is contracted after admission to the asylum.

Clouston further states that out of 97 cases of General Paralysis who died, 27 were phthisical. Meickle has stated that of all the general paralytics examined, post mortem, 26 per cent exhibited caseation or cavities, 12 per cent arrested phthisis, and 65 per cent pleuritic adhesions.

In the last report of the General Board of Commissioners in Lunacy for Scotland the percentage of deaths from phthisis in all Scottish asylums is given as 14.6 per cent. The percentage of deaths due to general paralysis for the same year was 14.8. If one takes into consideration the fact that many cases of/

of general paralysis really die of tubercular disease although returned as dying of general paralysis, the death-rate from tubercle must be higher than that above stated.

As during recent years, with improved hygienic conditions in asylums, the death-rate from phthisis has diminished among the insane, it is possible that at one time confinement in an asylum did act as a factor in swelling the tubercular death-rate. On the other hand, it cannot be denied, that many cases of phthisis admitted into asylums make most excellent recoveries, and the environments of the modern asylum do not suggest that tubercle should be an endemic disease.

In the Perth District Asylum, among patients drawn largely from a rural population, of the last hundred deaths 17were due to tubercular disease. Quite a number of phthisical patients are admitted, however, who are ultimately discharged recovered with no apparent signs of active tubercular disease.

It is reasonable to suppose that, if the insane contract phthisis through residence in asylums, the resistive power of those who have been long resident should be considerably below that of those recently admitted, provided that the patients so examined show no/

no symptoms of active tubercular disease.

On the other hand, if the insane, as a class, be more liable to phthisis than the sane, their average resistive power should be below that of the sane healthy population.

The recent researches of Wright and others on the opsonic power of human blood serum to the tubercle bacillus and other organisms, has opened up a field of enquiry which although at present little explored, has already, they contend yielded certain results, in so far, that it is now possible to calculate the resistive power of the individual, not only to tubercle but also to other organisms.

As Wright found that in cases of staphylococcal and tubercular infection with an entire absence of clinical symptoms, there was a diminished phagocytic power to those organisms as compared with that of healthy individuals, and this power could be increased by injections of the corresponding vaccine, he concluded that the lowered phagocytic power permitted infection to occur, and that the resistance to infection by any organism could be estimated by calculating the opsonic power of the blood serum. The results of observations recorded by Bulloch and others agree with those obtained by Wright, and support his conclusions.

It/

It occurred to me that in the study of the opsonic index of the insane resident in the asylum, we have a means of determining the question as to whether the insane contract tubercle as a result of residence in asylums or as a result of a lowered resistive power to infection by the tubercle bacillus.

With this object in view, I made observations on the opsonic indices of six members of the staff, who were, so far as could be ascertained, absolutely free from tubercular disease.

I also made observations on thirty cases of persons suffering from various forms of mental disease commencing with those most recently admitted and extending my observations to those who had resided in the asylum for so long a period as eleven years. All these cases were, at the time of observation free from active tubercular disease, but five showed evidences of having, at some time, suffered from tubercular infection. One of them had cicatrices in the neck. Four had flattening of the chest, with diminished movement, some dullness on percussion and increased vocal fremitus with prolonged expiration. Two of these were cases of general paralysis.

During their period of residence, none of the thirty cases observed had ever required medical treatment for any serious ailment.

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The opsonic index of the blood serum was determined for five consecutive days, and the average index of each case calculated for that period. In all cases the serum was compared with my own which was taken as unity.

To ascertain if any further information could be gained from the opsonic indices, I injected the control cases and the insane patients with Koch's New Tuberculin T.R.

Four of the control cases, and twelve of the insane received an injection of 1/500 mgr. T.R., while two control cases and eighteen insane cases were injected with 1/750 mgr. T.R. The opsonic indices were then observed for a further period and the results tabulated.

So far as is at present known, the opsonic index of human serum to the majority of organisms is very similar to that of tubercle. For purposes of comparison as between the healthy sane individual and the non-tubercular insane, I examined the indices of five control cases, and fifteen insane patients to the bacillus coli communis, staphylococcus aureus, and micrococcus rheumaticus for five days before the injection of T.R. was given and for some days thereafter.

Throughout the whole series of observations, the temperature and pulse rate were recorded twice daily in both the control and insane cases.

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The quantitative and qualitative leucocytosis was observed in all the control cases and in nineteen of the cases suffering from mental disease.

To observe the effect of the injection of tuberculin on the insane, the urine of ten patients who were confined to bed at the time, was collected before and after injection, and the amount of urea and chlorides excreted during each 24 hours recorded. At the same time, an accurate record of the albumen and chlorides ingested daily was made, and the difference between ingestion and excretion noted.

Daily notes were made upon the mental symptoms, particularly of the acute cases under observation.

For convenience of description, I divide the result of work done into:-

FIRSTLY Opsonic Indices to the Tubercle Bacillus.

A. In the control cases before the injection of tuberculin.

B. In the insane cases before the injection of tuberculin.

C. In the control cases after the injection of tuberculin.

D. In the insane cases after the injection of tuberculin.

SECONDLY. /

SECONDLY. Opsonic Indices to the Bacillus Coli Communis, Staphylococcus Aureus, and Micrococcus Rheumaticus.

A. In the control cases before the injection of tuberculin.

B. In the insane cases before the injection of tuberculin.

C. In the control cases after the injection of tuberculin.

D. In the insane cases after the injection of tuberculin.

THIRDLY. Observations on the Temperature and Pulse Rate of the Control and of the Insane cases, before and after the injection of Tuberculin.

FOURTHLY. Observations on the Quantitative and Qualitative Leucocytosis in the Control and Insane cases, before and after the injection of Tuberculin.

FIFTHLY. Observations on the Urinary excretion of the Insane cases before and after the injection of Tuberculin.

SIXTHLY. Observations on the Mental Symptoms produced in the Insane after the injection of Tuberculin.

SEVENTHLY/

SEVENTHLY. Summary and Conclusions.

In an appendix I have shown in tabular form some of the results obtained.

TECHNIQUE EMPLOYED.

Before reliable results can be obtained in estimating the opsonic power of the blood, considerable experience in the technique of the operation is necessary.

I had been engaged at this work for three months before I considered my results sufficiently accurate for the pusposes of this work. I have continuous records of many cases for so long as three weeks but, as I had records of only five consecutive observations in all cases prior to injection with tuberculin, I give the results for that period only.

The blood examined was taken at the same hour daily and therefore, as nearly as possible under the same conditions as to exercise and the digestive processes. Any change which these conditions may cause in the opsonic power of the blood, and which might lead to error in the results obtained, was thereby reduced.

The blood, in all cases, was taken from the lobe of the ear, which was purified before being punctured. The/

The first drop of blood was removed and a sufficient quantity for the number of observations being made was drawn into a straight glass pipette with capillary ends. The pipette was not quite filled. To prevent heating the serum, the vacant end of the pipette was sealed in a flame. After centrifuging, the serum separated from the corpuscles. The unsealed end of the pipette was then broken off and the serum exposed. My own serum, which was the control observed in every case, was drawn from my finger.

My leucocytes were also used during the observations. Blood was dropped directly from my finger, which was deeply punctured and bled freely, into a solution of 1 per cent citrate of soda in .85 per cent chloride of sodium solution. Two parts of this solution was put into a small tube set in a piece of cork, and the blood run into it, the whole being thoroughly mixed during the process. With a less dilution the blood tended to clot. This mixture was then centrifuged. The supernatent fluid was pipetted off, and the corpuscles again washed with a solution of .85 per cent sodium chloride. After centrifuging, this solution was drawn off with a pipette, and the corpuscles left in the tube. These were/

were gently stirred and the leucocytes fairly distributed.

Suspensions of the various organisms used, except tubercle were made every second day in a normal sodium chloride solution. In the case of the Tubercle Bacillus the contrast staining employed prevented any error of enumeration which might have resulted from the presence of contaminating organisms in the solution. The tubercle suspension was renewed at frequent intervals however. For tubercle a 1 in 1000 sodium chloride solution was used, as the clumping of the organism is said to be less with the weaker solution. The amount of tubercle powder necessary was moistened with the solution, and pounded in an agate mortar. More solution was added, and when the suspension was complete the whole was filtered into a small sterilised test tube.

The suspensions were made as nearly as possible of the same strength throughout, but as the same control was used in all cases, and the index calculated by the result obtained in the control case, no error results from a slight variation in the strength of the suspensions used from day to day.

Having obtained the blood serum leucocytes and organismal suspension, equal quantities of these three were measured in a capillary tube, and thoroughly mixed in/

in the cell of a hanging drop slide. The mixture was then drawn into a capillary tube, the end of which was sealed in a flame, and the whole incubated for 15 minutes at a temperature of 37 degrees C. At the end of that time the end of the capillary tube was snipped off, and the contents blown upon a slide. As even a film as possible was made, so that the leucocytes and the organisms not ingested were fairly distributed and not clumped at the edges of the film. Enumeration is prolonged by so doing, but the result is more accurate, as it can at once be seen whether the organism is actually inside or only lying on the top of the leucocyte.

The tubercle slides were stained with Ziehl-Nielsen stain, while all the others were stained with Jenner's Eosin and Methylene Blue.

An oil immersion lens, and a movable stage, fixed to the microscope used, are necessary for enumeration. The number of organisms ingested by a definite number of leucocytes is calculated in the control film. The number obtained was taken to represent unity, for that particular organism for that series of observations. From the comparison of the number of organisms ingested in the same number of leucocytes in the film of any case, with the number found in the control, the index of that case to the particular organism was obtained.

Never/

Never less that fifty leucocytes were counted in the estimation of the tubercle opsonic index, and in many cases 80 were examined. The contents of fifty cells were usually counted in the case of the other organisms observed, but on some occasions, only thirty were enumerated. The same number of leucocytes was examined at the same observation for any one organism.

The opsonic power of the control serum was very constant, the number of organisms ingested showing little variation from day to day when the same organismal suspension was used. As the same methods of procedure were used all through these observations, the amount of spontaneous phagocytosis which may occur does not affect the results obtained.

It was no part of my plan to attempt the elucidation of obscure theoretical points involved in the procedure adopted, but where my observations have any bearing on the practical utility of the methods employed, these points have been noted.

OPSONIC INDICES TO

THE TUBERCLE BACILLUS.

Opsonic Indices to the Tubercle Bacillus in the Control Cases prior to Injection with Tuberculin.

In six control cases the tuberculo-opsonic index was estimated for five consecutive days before injection.

The average index obtained by these observations was 1.07, the average for each case being.98, .97, 1.32, 1.06, 1.01, 1.11, the variation therefore being between .97 and 1.32.

Urwick found the average tuberculo-opsonic index in twenty healthy persons to be 1.006, while Bulloch found the average index of 84 healthy persons to be .96, the variation ranging from .8 to 1.2.

Lawson and Stewart obtained an average tuberculo-opsonic index of 1 in 25 healthy persons with a variation between .9 and 1.2. In none of these records however is any indication given as to how often each case was examined before the average index was calculated. As I have found a considerable daily variation in the opsonic indices of healthy persons, in my opinion a single observation cannot be relied upon to give a correct indication of the opsonic power of an individual. There is no indication given in these records either of the time when the observations were made. As it has been shown/

shown that in tubercular patients at least there is an increase in opsonic power after exercise, the observations ought to be made at the same hour daily and as nearly as possible under the same conditions.

Urwick states that there is little variation in the opsonic index of the same person from day to day. I found a considerable variation in the indices registered in the control cases from day to day. One of them fell as low as .65 on one occasion.

In cases of acute tubercular disease fluctuations in the opsonic index occur, some of the patients having indices which pass from subnormal to above normal on occasions, while others have a persistently high index. In none of the control cases examined was there any evidence of active or latent tubercular family history. I found however that the average opsonic index in my control cases differed very little from week to week and I have therefore based my results upon these averages. Considered in this manner the results of my observations on the control cases are very similar to those obtained by Lawson and Stewart in healthy country subjects.

The Tuberculo-opsonic Indices obtained in the Insane cases prior to Injection with Tuberculin.

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The 30 insane patients examined for five consecutive days gave an average index of .88. The variation was between .65 and 1.23. This result is below the indices obtained by Lawson and Stewart as well as those recorded in the six control cases examined by myself. The daily variation in the indices in the insane patients is also greater than in the control persons and the fluctuations are more marked, the rise and fall being abrupt.

The average indices of the five patients with evidences of old tubercular disease were:- 1.03, .96, .65, .84, .93, giving an average index of .88, the same as that found for all the 30 cases.

The difference between the index found in the 6 control cases 1.07 and that found in the insane patients examined - .88 is very striking. As the insane are admitted by all to be liable to tubercular infection,this observation is strong evidence in favour of the view expressed by Wright and previously stated,that the opsonic power of the blood serum can be used as a test of the liability to infection by particular organisms. That being so,it may be concluded that the insane as a class have a lowered resistive power to the tubercle bacillus as compared with the healthy sane population.

To/

To estimate whether the length of residence in an asylum has any bearing upon the liability of patients to contract tubercular infection, in the first table the patients examined are classified according to their length of residence.

TABLE I. Table classifying the Insane Patients according to their length of residence in the Asylum.

Length of Residence.	Number of cases.	Average Opsonic Index.
A. Under 6 months	8	.83
B. Over 6 months & under 1 year	5	.80
C. Over 1 year & under 2 years	3	.89
D. Over 2 years & under 3 years	3	.92
E. Over 3 years & under 4 years	4	.96
F. Over 4 years & under 5 years	4	.89
G. Over 6 years	3	.95.

This table shows that the average opsonic index of the patients in the classes A and B is lower than that found in any of the other classes whose length of residence in the asylum had been greater. That this is not due to the fact that the number of patients included/

included in these two classes is larger than that in any of the other classes is proved by the fact that the average tuberculo-opsonic indices of all the patients of less than one year's residence is .82, while the average index for all the 17 patients of longer residence is .92.

Length of residence in an asylum is therefore not a factor which of itself tends to lower the resistive power of the insane to tubercular infection but rather the reverse, as those patients who had resided for over two years in the asylum had an average opsonic index of .93 as compared with the index of .82 in those of under one year's residence.

As the chronic insane are believed to be more prone to tubercular infection than the acute cases the second table is drawn up so as to classify the patients according to their mental state.

TABLE II. Table classifying the Insane Patients according to their Mental State.

	Number of cases	Average Op: Index.
A. Cases with Acute Mental Symptoms	7.	.87
B. Cases with Subacute Mental Symptoms	8.	.86
C. Chronic Cases (Secondary Dementia)	11.	.93
D. Cases of General Paralysis.	4.	.79

This/

This table seems to me to point to the fact that the acutely insane have a much lower resistive power to tubercule than the chronic demented cases and it is quite possible that they become infected with tubercular disease during the period of onset of the mental disease.

The acute cases were all recent admissions except one, a case of mania who had been resident for more than 3 years but whose opsonic index was .95. With three exceptions these patients were adults. In all the demented cases the illness had commenced during adolescence.

All the general paralytic cases had been resident in the asylum for less than one year. Two of them showed evidences of having at some time suffered from tubercular disease but I could detect no symptoms of active disease at the time these observations were made. The average opsonic index of the remaining two cases was very low being only .78.

General paralytics are as a class very liable to tubercular infection and the low tuberculo-opsonic indices recorded in these four cases indicate that their liability to tubercular infection is due to their low resistive power.

Certain forms of mental disease are supposed to predispose/

predipose the patient to tubercular infection and the type of mental disease which is believed to be most frequently associated with tubercular infection is adolescent insanity. The three most common forms of insanity met with in adolescent subjects are acute mania, katatonia and hebephrenia.

Table 3 classifies the acute cases according to their form of mental disease.

TABLE III. Table classifying the Insane Patients with acute mental symptoms according to their form of Mental Disease.

Form of Mental Disease	Number of cases.	Average Tuberculo-Opsonic Index.
A. Adolescent Insanity	3 cases (Katatonia 1. Hebephrenia 2.)	.84
B. Melancholia	2 cases (adults)	.88
C. Mania	2 cases (adults)	.91

The table shows that the tuberculo-opsonic index of the acutely insane adolescent patients is lower than that of the acutely insane adults. It is interesting to compare this index in the acutely insane adolescent cases with that obtained in the 11 chronic cases in all of whom the mental disease had originated during adolescence. These 11 cases in spite of their state of dementia and in spite of their long residence in the asylum had a tuberculo-opsonic index averaging .92. Such a finding does not suggest that a lengthened asylum residence predisposes to tubercular ~~in~~ infection but it points to the fact that the resistive power to tubercle/

tubercle is lowered by the onset of mental disease. It is also an interesting fact that the tuberculo-opsonic index in the melancholic cases is only .88 as against .91 in the two cases of acute mania as it is an undeniable fact that adults suffering from maniacal excitement are much less prone to contract tubercular infection than adults suffering from melancholia.

Observations on the Control Cases after Injection with Tuberculin.

To estimate still further if there was any difference between the sane and insane persons in their reaction to tubercle, I injected the six control cases, all members of the asylum staff, with Koch's new tuberculin which will be subsequently referred to in this paper as T.R.

So far, the only record of such injections in healthy persons, is that recorded by Lawson and Stewart who injected 4 control cases; the dose of T.R. which they employed is not stated.

It is now generally believed that if a person is infected by any of the pathogenic organisms an injection of a vaccine of the infecting organism is followed by/

by an immediate fall in the opsonic power of the blood serum of the person so injected. The amount and duration of this fall, commonly spoken of as the negative phase, depends, according to Wright, on the amount of the dose of vaccine administered and if the dose injected be large enough, a temperature reaction and constitutional symptoms may be produced. The negative phase is followed by a positive phase, as it is called, when the opsonic power of the blood serum is increased. This positive phase may last a variable time, but ultimately the opsonic power falls back to the level at which it stood prior to injection.

In estimating the effect of the use of any drug or vaccine it is always necessary to take into consideration the idioscyncrasy of the individual to the particular drug or vaccine used. With a vaccine injection the idioscyncrasy of the person injected may be taken to represent the liability to infection by that particular organism from which the vaccine is made.

So far no exact definition of the term negative phase has been made. After months of careful work and by noting the differences found in the opsonic power of the blood serum of healthy persons to various organisms upon several successive days, I do not/

not consider that a reliable idea of the amount of fall in the phagocytic power produced by the injection of a vaccine can be obtained by a single observation of the opsonic power made before injection, even though daily observations are made thereafter. In many instances I found, especially in the insane cases, that a slight rise of the opsonic power occurred within 18 hours after the injection of the vaccine, which was followed by a very pronounced fall.

I therefore define a negative phase as; "Any fall in the opsonic index to a particular organism occurring at any time within 48 hours after the injection of the vaccine made from that organism: the index being below the level noted at the time of injection and also below the level of the average opsonic index for at least 5 days preceding the injection." Any fall, however slight, occurring within 48 hours and falling below the two levels stated is described as a negative phase in the following observations.

The Opsonic Indices of the Control Cases after Injection with T.R.

Four of the control cases were injected with 1/500 mgr. T.R. Two of them gave a distinct negative phase. The fall in the opsonic power was immediate and/

and lasted in the one case 2, and in the other 3 days, reaching .59 and .63 respectively. The subsequent rise was rapid, reaching 1.57 in the one and 1.74 in the other on the sixth day after injection. The average index of one of these cases prior to injection was .98 and of the other 1.32.

In the remaining 2 control cases injected with 1/500 mgr. T.R. no negative phase followed injection.

In the healthy persons injected by Lawson and Stewart no negative phase occurred. As the results I obtained did not agree with the observations recorded by Lawson and Stewart, I concluded that the dose of T.R. which I had used was too large. The remaining two control persons were therefore injected with 1/750 mgr. T.R. and with this dose no negative phase occurred in either of them. The rise in the tuberculo-opsonic power occurring after injection in these two controls was immediate, the maximum being reached the day following injection. The average index of these two control cases prior to injection was high being 1.01 and 1.11 and they rose to 1.25 and 1.38 respectively.

As all the control persons were in good health and free from tubercular infection it is probable that the large dose of T.R. used in the first four cases accounts for the occurrence of the two negative phases recorded. It is necessary however to state that/

that one of the two control cases who presented a negative phase after injection had a tubercular family history.

No rise of temperature or constitutional symptoms occurred as the result of injection in any of the control cases.

The Opsonic Indices of the Insane Patients after Injection with T.R.

Twelve of the insane patients received an injection of 1/500 mgr. T.R. Eleven of them, or 91 per cent, gave a negative phase after injection. Four of the patients who gave a negative phase had in the first instance a slight rise in the tuberculo-opsonic index. This initial rise was followed by a decided fall which was complete in all the cases on the third day after injection. In the insane patients who gave a negative reaction it was noticed that the fall in the tuberculo-opsonic index was gradual and prolonged when compared with the same fall in the two control cases who gave a negative reaction, and in whom the fall in the curve of the tuberculo-opsonic index was abrupt. The onset of the positive phase in the insane patients was gradual and prolonged the majority taking longer to attain their maximum than the two control cases who showed a similar reaction.

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The insane patients also at the height of their positive phases failed to reach such a high level of tuberculo-opsonic power as the two control cases who showed a negative reaction.

In other words the positive reaction to the injection was much slower and less pronounced in the insane patients than in the control cases.

In two of the insane patients who presented signs of old tubercular disease the negative reaction after injection was much less marked than in some of the other insane patients who presented no signs of old tuberculosis.

On comparing the results of the injection of tuberculin upon the opsonic indices of the acutely insane and chronic cases I find that in the acute cases the negative phase produced was more marked than in the chronic cases and that the succeeding positive phase was prolonged. The three most chronic cases who were injected with 1/500 mgr. T.R. showed a much less marked and prolonged reaction, than the acutely insane.

These observations would seem to indicate that the resistive power of the patients suffering from acute mental disease was less than that of the more chronic cases who had to some extent recovered their power/

power of resisting tubercular infection but in whom the mental disease had left irreparable brain damage. The views recently advanced, that many of the acute forms of insanity owe their cause to bacterial toxines may explain this difference in reactive power, if it can be proved that a severe organismal infection by one organism lowers the resistive power of the human body to other organisms. If this should be so, then the acutely insane have their resistive power so reduced as to render them liable to any form of infection, while the chronic cases, who have recovered from the acute toxaemia, although left with damaged brain cells, have, to some extent, regained their general resistive power, at all events this seems to apply to tubercular infection. Elsewhere I have recorded observations upon the opsonic indices of the insane and controls to organisms other than tubercle.

It may also be further deduced from these observations that prolonged residence in an asylum does not predispose the patient to tubercular infection as the acutely insane, all of whom had been resident for periods under one year showed a deficient reactive power when compared with the chronic cases, many of whom had been many years resident. This conclusion is also supported by comparing the opsonic indices/

indices of the insane patients as shown in Table No.I where, as has already been pointed out, the more recently admitted cases, who were also the acutely insane, had a lower tuberculo-opsonic index than the patients who had been longer resident and were therefore chronic cases of mental disease.

That so large a proportion as 91 per cent of the insane cases should show a negative phase after injection with 1/500 mgr. T.R. as against 50 per cent in the control cases seems to indicate that the resistive power of the insane to tubercular infection is less than that of sane persons. That such a large proportion of both the same and insane should give a negative phase after injection is probably due to the fact that 1/500 mgr. T.R. is too large a dose. In none of the twelve patients injected with this dose however were there any constitutional symptoms.

Eighteen insane patients were injected with 1/750 mgr. T.R. Of these only 4 showed a negative phase. That is to say 22. per cent as compared with 91 per cent of those injected with 1/500 mgr. T.R.

Only one of these four patients showed evidences of old tubercular disease and that one patient was a case of general paralysis.

~~With the exception of the case of general paralysis~~

The/

The average tuberculo-opsonic indices for the 5 days prior to injection did not lead one to expect that a negative phase would follow injection. In these cases one of them had an index of 1.07.

In the remaining 14 cases of this series injected with 1/750 mgr. T.R. in whom no negative phase supervened the maximum rise of the positive phase was reached much more slowly than in the two control cases injected with the same dose. In only two of these cases was there an immediate rise to the maximum tuberculo-opsonic index on the day following injection, while in the majority of the cases four days were required to reach that point.

All the patients injected with 1/750 mgr. T.R., with the exception of four who suffered from general paralysis, were subacute or chronic cases and, with only two exceptions, they had been resident for more than two years in the asylum.

The difference between the reaction in the two control cases and the eighteen insane patients injected with 1/750 mgr. T.R. was the slow reaction of the insane after injection. Both the control cases reached their maximum on the day following the injection, while the insane patients took an average of 4 days to reach the same positive maximum. There was/

was however no difference in the maximum positive level ultimately reached in both the control and insane patients.

The result obtained in these two control cases corresponds with that recorded by Lawson and Stewart in the four healthy persons they examined.

Wright has stated "that the results of his observations seem to suggest that the development of a negative phase following a dose of T.R., smaller than that which would produce this result in a healthy person, may prove to be an index of tubercular infection. Such a conclusion would be in harmony with our experience in connection with the therapeutic inoculation of T.R. vaccine (New Tuberculin). We find in this connection that the negative phase supervenes upon a very much smaller dose and persists much longer in the case where the patient is the subject of extensive infection than in the contrary case."

As the result of the observation made by Lawson and Stewart upon the four healthy persons whom they injected with tuberculin, they state "The appearance of a negative phase after inoculation with a small quantity of tuberculin (T.R.) should enable one to distinguish between the blood of a subject of tubercular invasion and that of a person in sound health."

Of the six control cases whom I injected with tuberculin, two, as previously stated, gave a negative reaction. Both these control cases, as well as the eleven non-tubercular insane patients who also gave a negative reaction, were injected with 1/500 mgr. T.R., I therefore conclude that this dose is too large for diagnostic purposes.

The results obtained with an injection of 1/750 mgr. T.R. are very different. Neither of the control cases so injected showed a fall in the tuberculo-opsonic power, while of the 18 insane patients similarly injected only 4, or 22.2 per cent, presented a negative phase.

Of these four insane patients who showed a negative phase after injection one presented signs of former tubercular disease. The other three presented no signs or symptoms of tubercular infection, but the evidences of early tubercular disease are admittedly difficult to detect in the insane.

The tuberculo-opsonic indices prior to injection in these four patients who showed a negative phase were much more irregular than the tuberculo-opsonic indices in the 14 cases who gave no negative reaction.

The same fact was noted in the tuberculo-opsonic indices of the control cases and insane patients injected with 1/500 mgr. T.R. In those who gave no negative phase the tuberculo-opsonic indices prior to/

prior to injection were very regular showing little variation from day to day, while the tuberculo-opsonic indices of those who gave a negative phase showed considerable daily variation.

Wright has shown that a fresh injection of tuberculin given during the negative phase, induced by a previous injection, produces a cumulative effect, that is to say it still further emphasises the negative phase. It is therefore possible that in those who are already infected with tubercle that an injection given when the tuberculo-opsonic index was much below or much above the healthy average, might produce very different results. In the control persons and the insane patients upon whom I made these observations however, I could detect no connection between the level of the tuberculo-opsonic index on the day of injection and the subsequent presence or absence of a negative phase.

It is therefore probable that the amount of tuberculin administered has a more important bearing on the production of a negative phase after injection in non-tubercular persons than the level of the tuberculo-opsonic index at the time of injection and as I have already pointed out the amount of variation in the tuberculo-opsonic index prior to injection has also to be considered in estimating the occurrence or absence of a negative phase after inoculation.

OPSONIC INDICES TO THE BACILLUS COLI COMMUNIS, STAPHYLOCOCCUS AUREUS AND MICROCOCCUS RHEUMATICUS.

While making observations with the tubercle bacillus, I, at the same time, examined the opsonic power to other organisms, of five control cases and fifteen insane patients:-

In Wright's earliest researches on the opsonic body in human blood serums he used various forms of staphylococci. He found in various forms of staphylococcal invasion, such as Acne, Furunculosis and Sycosis, that the index of the patient so infected was lower than that of an ordinary healthy individual to the particular organism causing the disease. By his method of inoculation of a vaccine made from the infecting organisms he was able to greatly improve the condition and even cure most intractable cases. Bullock has obtained like results and cases have been recorded where pneumococcal and other infective diseases have been cured by similar treatment.

Although there are no statistics to support the statement, I have found during my residence in the Perth District Asylum that the insane frequently suffer from acne, boils, and other low forms of inflammation. From many such cases I have isolated a staphylococcus aureus. Clouston states that boils and skin irritations are common in some forms of mental disease.-

Cystitis occurs frequently in asylums, even in fairly healthy patients. In many cases I have found the bacillus coli communis, or an allied organism, present in the urine. Obscure intestinal lesions are also common amongst the insane and may, in some cases, be associated with this microbe. Johnstone and Goodall found agglutinins to various strains of the bacillus coli communis in the blood of 60 per cent of insane cases examined by them. For my observations, therefore, I used staphylococcus aureus, and bacillus coli communis. The growth of the bacillus coli used was obtained from the faeces of a patient. The staphylococcus aureus was obtained from the bone marrow of a case of acute mania who died in a typhoid state. It was tested by Dr. Dowson of Messrs Burroughs Welcome & Co's Pathological Laboratory and was pronounced by him to be a pure culture of this organism.

Dr. L.C.Bruce has isolated streptococci from the blood of a case of acute mania and also from a case of a form of adolescent insanity - katatonia, - and has found agglutinins to these organisms in the blood of the majority of patients suffering from the same diseases.

Erysipelas is also relatively more common amongst the insane than amongst the sane population.

In/

In the district from which the Perth District Asylum draws its patients rheumatism, in its various forms, is perhaps the most common ailment. Rheumatism, however, does not appear to be more common in the asylum than in the country round. Although rheumatism is not a common cause of insanity it is so in some cases and Clouston, in his book on Mental Diseases gives a most graphic description of a case of rheumatic insanity. He also quotes statistics to show the important relationship between rheumatic attacks and the periods of puberty and adolescence. As almost 50 per cent of all the persons on whom observations were made were adolescents, or, if insane, in whom the illness had begun in adolescence, I used the micrococcus rheumaticus as the type of streptococcus. I found it much easier to work with than any other strain of streptococcus obtainable, as it did not clump so readily in solution and was, therefore, more easily counted and gave more accurate and reliable results.

Opsonic Indices of the Control Cases to Bacillus Coli, Staphylococcus Aureus and Micrococcus Rheumaticus prior to Injection with Tuberculin.

Five/

Five control cases were examined to these organisms for five consecutive days.

To the bacillus coli the average index was 1.02., the variation ranging between .84 and 1.14. The variation in the individual cases is greater than to tubercle, and is more easily affected by outside influence. In one case, who attended a public dinner the previous evening, the index to bacillus coli recorded at the usual hour next morning was 1.5 while there was no marked difference in the indices obtained to the other organisms employed at this observation. In these five control cases the average tuberculo opsonic index was 1.08 which is not much higher than that found to bacillus coli.

The average index of the five control cases examined to staphylococcus aureus was 1.1, with a variation between .89 and 1.45. One case had invariably a very high index to this organism - reaching on one occasion 1.63. The variation in the other cases was not very great. The index to this organism is rather higher than that to tubercle in the same cases being 1.1 as against 1.08.

In the case of the micrococcus rheumaticus the same five cases gave an index of 1.07. The variation ranged between .89 and 1.22. The variation in the individual cases is also wide. The average tuberculo-

opsonic index in these cases was 1.08, the variation being between .97 - 1.32.

TABLE IV. Table showing the average opsonic indices of the control cases to Tubercle Bacillus, Bacillus Coli, Staphylococcus Aureus and Micrococcus Rheumaticus.

T.B.	B.C.	S.A.	M.R.
1.08	1.02	1.1	1.07.

There is, therefore, very little difference found in the average index of sane healthy individuals tested to these four organisms. That to bacillus coli is lowest, and shows the least variation, while that to staphylococcus aureus is highest and shows the greatest amount of variation. On examining the amount of variation to each variety of organism, in each case individually, the range is greatest to micrococcus rheumaticus, bacillus coli holding second place, while the index to staphylococcus aureus is most constant.

Opsonic Indices of the Insane Patients to Bacillus Coli, Staphylococcus Aureus and Micrococcus Rheumaticus prior to Inoculation with Tuberculin.

In/

In twelve insane patients the average opsonic index to bacillus coli was 1.06, the variation being between .81 and 1.28. This result compares favourably with that found in the control cases although the variation is greater. In the same cases the tuberculo-opsonic index was .97 with a variation between .68 and 1.23. In 15 cases tested to staphylococcus aureus the index was 1.07 with a variation ranging between .91 and 1.38. This differs very slightly from the results obtained in the control cases. In the same cases the average index to tubercle was only .9.

Eleven cases who were observed to the micrococcus rheumaticus, gave an average index of .94, the variations being between .78 and 1.21. This result is below the index of the control cases and the variation observed is greater. The average index to tubercle in the same series of cases was .91. The amount of variation to the tubercle bacillus was the same in each series of observations viz. .68 to 1.23. When the cases are examined individually the range of variation is found to be greater in the insane patients than in the control cases.

TABLE V./

TABLE V. Table comparing the Tuberculo-opsonic Indices with Indices obtained to the Bacillus Coli, Staphylococcus Aureus & the Micrococcus Rheumaticus in the same series of Patients.

Average Opsonic Index	to	B.C.	1.06	to	T.B.	.97
"	"	"	S.A.	1.07	"	T.B. .9
"	"	"	M.R.	.94	"	T.B. .91

The tuberculo-opsonic index is below the opsonic index of these other organisms in the insane cases and the range of variation greater.

Except in one case where a boil developed towards the end of these observations, none of the patients were known to suffer from any infective condition and all carious teeth or other source of infection had been removed, as far as possible, before the work was begun.

TABLE VI. Table comparing the Average Opsonic Indices of the Control Cases to the Tubercle Bacillus, Bacillus Coli Communis, Staphylococcus Aureus and Micrococcus Rheumaticus with those of the Insane Patients to the same Organisms.

	T.B.	B.C.	S.A.	M.R.
Control cases.	1.08	1.02	1.1	1.07
Insane cases.	.88	1.06	1.07	.94

With the exception of bacillus coli the average opsonic index of the control cases was higher to all the organisms used in these observations, than in the insane patients. The amount of difference between the two averages to bacillus coli was very small and less than what was found in the case of any of the other organisms.

It may therefore be concluded that the resistive power of the insane to organismal invasion is less than that of the sane healthy population.

The changes in the Opsonic Indices to Bacillus Coli, Staphylococcus Aureus, and Micrococcus Rheumaticus, which occurred in the Control cases after Injection of Tuberculin :

The observations with bacillus coli, staphylococcus aureus and micrococcus rheumaticus, were continued after the injection of tuberculin. Each of the four of the control cases, who were injected with 1/500 mgr. T.R., showed a negative phase to staphylococcus aureus. Three had a diminution of opsonic power to bacillus coli and two to the micrococcus rheumaticus.

Of the two cases who showed no negative phase to tubercle after injection, one had a fall in opsonic power to all the three organisms tested, while the other/

other gave a similar result with bacillus coli and staphylococcus aureus.

Two cases developed a negative phase to the tubercle bacillus after the injection of tuberculin, one of these gave a similar reaction with all three organisms, while the other only did so to staphylococcus aureus.

TABLE VII. Table showing number of Negative Phases in the Control Cases to the Tubercle Bacillus, Bacillus Coli, Staphylococcus Aureus and Micrococcus Rheumaticus following the Injection of 1/500 mgr. T.R.

	T.B.	B.C.	S.A.	M.R.
A.	N.	N.	N.	N.
B.	O.	N.	N.	O.
C.	N.	O.	N.	O.
D.	O.	N.	N.	N.

All the control cases, therefore, gave a negative phase to one or other of these organisms, the bacillus coli, staphylococcus aureus, and micrococcus rheumaticus after injection with T.R.

Of the twelve series of observations made to other organisms after the injection of tuberculin in nine instances a negative phase resulted, that is in 75 per cent of the total.

Only one control case injected with a 1/750 mgr. T.R. was tested to the three other organisms employed. No negative phase to tubercle was produced in this case, but there was a loss of opsonic power to the micrococcus rheumaticus after injection.

Opsonic Indices of the Insane Patients to the Bacillus Coli, Staphylococcus Aureus and Micrococcus Rheumaticus after Injection of 1/500 mgr. T.R.

Nine insane patients injected with 1/500 mgr. T.R. were tested to bacillus coli after injection and in all a negative phase resulted. All twelve insane cases who were injected with a similar amount of T.R., were tested to staphylococcus aureus and in eight of these cases a negative phase followed, that is 66 per cent of the total.

Of eight cases in the same series examined to micrococcus rheumaticus five gave a negative phase that is 62 per cent.

TABLE VIII. Table showing percentage of Negative Phases to all the Organisms used in the Control Cases and Insane Patients after the Injection of 1/500 mgr. T.R.

	T.B.	B.C.	S.A.	M.R.
Control	50	75	100	50
Insane	91	100	66	62

On comparing the results obtained in the control cases with those in the insane to each organism it was seen that the percentage of cases where a negative phase was observed after injection was less in the control than in the insane cases to tubercle, bacillus coli, and micrococcus rheumaticus, but greater in the control cases than in the insane patients to staphylococcus aureus.

Opsonic Indices of Insane Patients to the same Organisms after the Injection of 1/750 mgr. T.R.

Only three cases injected with 1/750 mgr. T.R. were tested to the other organisms.

One of these cases gave a negative phase to tubercle after injection but one of them showed this reaction to all the other organisms. One had a fall in opsonic power to bacillus coli only. The third case did not react in this way to any of the organisms.

TABLE IX. Table showing number of negative phases in the Insane cases to the Tubercle Bacillus, Bacillus Coli, Staphylococcus Aureus and Micrococcus Rheumaticus after the Injection of 1/750 mgr. T.R.

	T.B.	B.C.	S.A.	M.R.
Case 17	O.	N.	N.	N.
" 20	N.	O.	O.	O.
" 29	O.	N.	O.	O.

In some cases the fall in the opsonic curve to these organisms was slight and the continuation of the curve showed little change from what it was before the injection of tuberculin, but in many the curve closely resembled that of a typical negative phase to tubercle.

After an injection of either 1/500 mgr. T.R. or 1/750 mgr. T.R., I find the number of cases in which a negative phase results is greater in the insane than in the sane.

A series of sixteen observations were made on the control cases after injection with 1/500 mgr. T.R. With all four organisms used, namely tubercle bacillus, bacillus coli, staphylococcus aureus and micrococcus rheumaticus. In all, there were eleven negative phases produced after injection, that is in 68.7 per cent.

A series of forty-one observations were made on the twelve patients who were similarly injected. Of this total thirty-three showed a negative phase, that is 80.4 per cent.

With/

With an injection of 1/750 mgr. T.R. one control case showed a negative phase in twenty-five per cent of the observations made.

Twelve observations were made on the three insane patients who were injected with the same dose. In these a negative phase occurred in 41.6 per cent.

It is, therefore, reasonable to conclude that the general resistive power of the insane to organismal infection is less than that possessed by the sane.

Comparison of results obtained in the Control, Acute, and Chronic Cases to Tubercle Bacillus, Bacillus Coli, Staphylococcus Aureus, and Micrococcus Rheumaticus, before and after the Injection of Tuberculin.

A comparison of the results obtained in the different classes of cases examined to the organisms used during these observations before and after the injection of tuberculin would lead one to suppose that there is a difference in the resistive power to organismal invasion between these various classes.

In five control cases tested to all the organisms employed before injection of the tuberculin the tuberculo-/

tuberculo-opsonic index was 1.08. Of the seven acute cases of mental disease examined to two or more organisms the tuberculo-opsonic index before injection was .87 as compared with .93 in eight chronic cases tested to all the organisms.

The five control cases give an average index of 1.02 to bacillus coli. In four acute cases the index to the same organisms was .96 and in eight chronic cases 1.06.

To staphylococcus aureus the index recorded in the control cases was 1.1. The index in the seven acute cases was 1.01, while in the chronic cases the index was 1.12.

The index to the micrococcus rheumaticus in the control cases was 1.07. In three acute cases tested to this organism the index was .9 and in the chronic cases .96.

TABLE X. Table showing average indices of the different classes of cases to the various organisms before the injection of tuberculin.

	T.B.	B.C.	S.A.	M.R.	Aggregate Average.
CONTROL	1.08	1.02	1.1	1.07	1.04
ACUTE	.87	.96	1.01	.9	.93
CHRONIC	.93	1.06	1.12	.96	1.01

To/

To each of the organisms tested the average index of the acute cases was found to be below that of the control cases and also of the more chronic patients. The average index of the chronic cases is below that of the control cases to tubercle and micrococcus rheumaticus but slightly above the control average index to bacillus coli and staphylococcus aureus. As will be seen from the foregoing table the aggregate average of the control cases is 1.04 while that of the chronic cases is 1.01.

As no acute case was injected with 1/750 mgr. T.R., no comparison can be made between the various classes of cases after the injection of that dose.

In sixteen observations made on the four control cases injected with 1/500 mgr. T.R. eleven negative phases followed-that is 68.7 per cent.

Of the twelve patients who were injected with the same dose, and examined to at least two of the organisms used during these observations, seven are classified as suffering from acute mental disease. A series of twenty-one observations were made on these cases and in seventeen a negative phase was produced, that is in 80.9 per cent.

Five cases similarly injected were classified as subacute or chronic and had been resident in the asylum from one to six years. On these, twenty observations were made and a negative phase resulted in/

in sixteen, or a proportion of 80 per cent.

TABLE XI. Table showing proportion of Negative Phases in the different classes of cases after injection with 1/500 mgr. T.R.

CONTROLS	ACUTES	CHRONICS
68.7	80.9	80.

The percentage of negative phases produced is highest in the acute cases and lowest in the control cases. This result agrees with the conclusion arrived at from a consideration of the preceding table.

The more chronic cases, have, therefore, a greater resistive power to organismal infection than the more acute and recent cases but they are more liable to infection that the sane healthy population.

Relation of Index before Injection to the Number of Negative Phases following Injection.

That the average of the four control cases injected with 1/500 mgr. T.R. is higher to all the organisms used in these observations than in the corresponding twelve insane cases is shown in the following table.

TABLE XII./

TABLE XII. Table of average opsonic indices to the various organisms prior to injection with 1/500 mgr. T.R.

	T.R.	B.C.	S.A.	M.R.
CONTROL CASES	1.08	.99	1.15	1.07
INSANE CASES	.82	.98	1.04	.94

The difference in the percentage of negative phases following injection of 1/500 mgr. T.R., in the control and in the insane cases, is similar to the difference between their average opsonic indices before injection, the figures being, 68.7 in the control cases, and 80.5 in the insane cases.

With the exception of staphylococcus aureus, the percentage of negative phases to each organism was less in the control than in the chronic cases; and this was the only organism in which the amount of variation, (in the figures from which the average index was calculated), was greater in the control cases than in the insane. The range of variation was from .9 to 1.4 in the healthy, and from .9 to 1.2 in the insane. This fact may help to explain the greater number of negative phases obtained after injection in the control cases.

Relation/

Relation of the Dose of Tuberculin injected to the Number of Negative Phases occurring after such Injection:-

To estimate the effect of two different doses of tuberculin on the number of negative phases produced, the same type of case must be examined in both instances. I have only examined sub-acute and chronic cases after the injection of both 1/500 mgr. T.R. and 1/750 mgr. T.R.

Twenty observations were made on the five cases injected with 1/500 mgr. T.R. and in sixteen instances a negative phase resulted, that is in 80 per cent. Three cases were injected with 1/750 mgr. T.R. Twelve series of observations were made in these cases after injection and in five a negative phase was produced, that is in 41.6 per cent. The larger dose, therefore, produces a higher percentage of negative phases after injection.

The fact here demonstrated that the injection of a large dose of tuberculin lowers the resistive power of the human body to invasion by organisms other than the tubercle bacillus, taken in conjunction with the fact that the bacterial resistive power of the cases of acute mental disease is lower than that possessed by the more chronic cases, somewhat supports the/

the view that acute insanity is due to bacterial toxaemia.

Specificity of the Opsonic Body and Diagnostic Value of the Negative phase:-

Bulloch claims to have demonstrated that the opsonic body in the blood serum is largely specific to its own special organisms. He based this claim on two experiments. He first tested the serum against tubercle and staphylococcus albus. The serum was then mixed with one or other of these microbes and, after incubating and centrifuging the mixture, the supernatant fluid was tested against both organisms. The fluid was found to have largely lost its opsonin for the particular microbe with which it had been in contact, while it largely retained its opsonin for the microbe with which it had not been digested. In the second case, the serum of human beings was repeatedly tested against both tubercle and staphylococcus. Injections of tuberculin produced an increase in the tuberculous opsonin while leaving the quantity of staphylococcus opsonin unaltered and vice versa. He, however, does not state the dose given in his experiment.

I have made no experiments of the nature of the first experiment described by Bulloch.

I have found that with a dose of 1/500 mgr. T.R. in healthy persons there is a fall in opsonin power produced to other organisms. In the one control case injected with a dose of 1/750 mgr. T.R., no fall was recorded to tubercle; but a negative phase followed in the case of the micrococcus rheumaticus. There was a rise recorded, however, at the first observation made eighteen hours after injection, but this was succeeded by a fall below any point previously recorded. In the three insane cases where 1/750 mgr. T.R. was given, four negative phases were recorded after injection to the three organisms which were used.

The demonstration of the specificity of the opsonic body in the blood serum is necessary to support the view that the production of a negative phase, following the injection of a minute dose of tuberculin, is diagnostic of infection by the tubercle bacillus. My observations demonstrate that for such diagnostic purposes a dose of 1/750 mgr. T.R. is too large and that to give reliable results a much smaller dose is required in the insane than in the sane individual.

A diminution of 1/250 mgr. T.R. in the dose administered caused a marked reduction in the proportion/

proportion of negative phases following injection in healthy cases. A smaller dose than I have used has been found to produce a negative phase in infected cases. It is therefore probable that further investigation along the line of my observations may lead to some definite results as to the diagnostic value of the negative phase after injection of a smaller dose of tuberculin.

Observations on the Temperature and Pulse rate of the Control and of the Insane Cases before and after the injection of Tuberculin:-

In no case was there any marked reaction either in temperature or pulse rate following the injection of tuberculin.

In one control case there was a slight rise of temperature, but this was probably due to an attack of coryza and not to the injection of tuberculin as no negative phase occurred. Two cases showed an increased pulse rate. One, in whom a negative phase followed the injection, had a pulse rate of 76 beats per minute on the evening of injection. The rate next morning was 92 per minute. There was no other symptom/

symptom what-so-ever. The other case gave no negative phase, and the pulse rate on injection was 74 per minute. Next evening it was 92 and the evening following 102. This increased pulse rate was not accompanied by a rise of temperature.

Beyond a slight feeling of stiffness in the flank at the site of inoculation there was no local irritation in any case. This soon passed off and all performed their usual duties without the slightest inconvenience.

The temperature chart of the insane frequently shows greater variation than that of sane healthy persons.

The comparison of the temperature charts and pulse rates, before and after injection, of those patients to whom a dose of 1/500 mgr. T.R. was administered, shows no greater variation than had occurred in the same case during the week preceding injection.

Only two of all the eighteen cases injected with 1/750 mgr. T.R. showed a rise of temperature above normal. One was a general paralytic whose temperature rose to 99°F. on the second day after injection, but, as sudden rises of temperature are common in such cases, no weight can be attached to this. The other case was a demented patient whose temperature rose steadily/

steadily from 98.2°F. on the evening of injection, to 99.2°F. the second evening thereafter; but there was no corresponding change in pulse rate and no negative phase was produced. This patient was inclined to be restless at the time of injection and was inoculated in the interscapular region, instead of the flank as in all the other cases, but no local irritation was produced and she did her usual work in the laundry next morning.

Only one case showed any increase in pulse rate after being injected with 1/750 mgr. T.R. This was a case of general paralysis whose pulse rate on the evening of injection was 77 per minute. The following evening it was 89 per minute and on the second evening after injection, when he was restless, rolling about in bed and picking the bed clothes it was 94. He showed evidences of old lung disease, but gave no negative phase after injection and no local or other constitutional symptoms were present.

The absence of local and constitutional symptoms was very marked, and in striking contrast with the effect produced by the large injections of Koch's old tuberculin formerly used for diagnostic purposes. With such injections rise of temperature and increased pulse rate, accompanied by malaise, headache, and local irritation, occurred even in healthy persons while in/

while in tubercular subjects these symptoms were more marked. With smaller doses for diagnostic purposes the patient was confined to bed and injected with 1 c.c. of a .001 solution of tuberculin. The temperature was taken every three hours. If the temperature rose two degrees F. or more within twelve hours tubercle was diagnosed.

If, as Wright suggests, the production of a negative phase, by the injection of a much smaller dose than produces that result in the healthy individual, can be used for the purpose of diagnosing tubercular disease, the benefit conferred on humanity will be very great as there will be no risk of stirring up old foci of disease or producing disagreeable symptoms.

Observations on the Quantitative and Qualitative Leucocytosis in the Control and Insane cases before and after the Injection of Tuberculin.

It is possible that the quantity and quality of the opsonic body in the blood serum may, in some way, be connected with the activity of the white blood corpuscles in the blood, as in infective conditions there is almost invariably a rise in the number of leucocytes./

leucocytes.

I estimated the leucocytosis, both quantitatively and qualitatively, daily in all the control cases and in seventeen insane cases during these observations. In two other insane patients the blood estimation was only carried out for three days prior to injection but was performed for six days after.

In all cases the technique employed was the same. Blood, for purposes of leucocyte estimation, was obtained at the same time as that used for opsonic observations. No pressure was applied to the ear while blood was being withdrawn. An ordinary haemocyte pipette was then filled to the mark 1 with blood, and the bulb filled to the mark 101 with ordinary leucocyte diluting fluid, .3 per cent acetic acid coloured with methyl green. The whole was then thoroughly mixed. For enumeration the slide of a Thoma-Zeiss haemocytometer was used, care being taken that the drop on the slide was the correct size to fill the cell. The entire square was counted in three separate fields and the average calculated. The result multiplied by 1000 represents the total number of white blood corpuscles in 1 c.m.m. of blood. For convenience, a moveable stage was fixed to the microscope and the ordinary high power lens employed.

Films/

Films for qualitative estimation were made on slides and stained with Jenner's eosine and methylene blue stain. An oil immersion lens was used for enumeration. Never less than 300 cells were counted. The total number of leucocytes per c.m.m. of blood being obtained, and the percentage of each variety calculated, the total of each variety per c.m.m. of blood was found and all comparisons between the various varieties are made on the totals so obtained.

The following varieties of white blood corpuscles were recognised:-

1. Polymorphonuclear leucccytes with neutrophile granules.
2. Small lymphocytes; cells about the size of a red blood corpuscle with a deeply stained nucleus which occupies nearly the whole of the cell, the perinuclear protoplasm being of very limited extent and staining with basic dyes.
3. Large lymphocytes; cells larger than a red corpuscle with a nucleus which stains less darkly than in the ordinary lymphocyte; the perinuclear protoplasm being well marked and staining with basic dyes. We also include under large lymphocytes the hyaline or large mononuclears, cells which vary from 8 - 12 μ in diameter. The nucleus is large and stains faintly. The cell protoplasm also stains very faintly with the basic dyes.

4./

4. The eosinophile leucocyte.

5. Mast cells with large violet granules.

The normal number of white blood corpuscles and of the several varieties per c.m.m. of blood varies within wide limits; but the usual total given is 7000, with the different varieties in the following per centage; polymorphonuclear 70, small lymphocytes 20, large lymphocytes 8, eosinophiles 2, mastcells .5 to 1.

LEUCOCYTOSIS OF THE CONTROL CASES BEFORE INJECTION:-

In the four male control cases the average total leucocyte count was 7,978, the percentage was polymorphonuclear 56.2, small lymphocytes 32.1, large lymphocyte 9, eosinophiles 2.5, mastcells .2. This result is considerably below the number usually quoted for polymorphonuclears, but higher in lymphocytes. For the two female control cases the average was 7817. The differential percentage was; polymorphonuclear 64.5, small lymphocytes 29, large lymphocytes 5.2, eosinophiles 1.1, mastcells .2. This percentage shows little change from that usually quoted. The average leucocytosis per c.m.m. obtained in all six control cases was 7824, the percentages being polymorphonuclear 59.7, small/

small lymphocytes 30.5, large lymphocytes 7.5, eosinophiles 2.1, mastcells .2.

Leucocytosis in the Insane Cases before Injection:-

In six chronic cases, all females, whose leucocytes were enumerated daily the total average was 9881 with a percentage of polymorphonuclear 62.5, small lymphocytes 27.1, large lymphocytes 8.6, eosinohpiles 1.5, mastcells .3. The total number of white blood corpuscles per c.m.m. of blood in the female insane patients is slightly above the normal but does not reach pathological limits. The percentage of each variety does not differ greatly from the control figures. In two cases of general paralysis, both males, the total leucocytosis was 10,705 with a percentage of polymorphonuclear 70.5, small lymphocytes 20.4, large lymphocytes 8.2, eosinophiles .8, mastcells .1. The total number of leucocytes is above the ordinary healthy level of the male, and shows a considerable increase on the total, and also on the percentage of polymorphonuclear leucocytes, found in the control cases. In one male chronic case, the average total leucocytosis was 7808, the percentage being polymorphonuclear 65.3 small lymphocytes 21, large/

large lymphocytes 9.6, eosinophiles 4, mastcells .1. There is an increased proportion of polymorphonuclear and eosinophile cells, but, otherwise, little change from the control count.

Leucocytosis of Control Cases after Injection.

After injection with 1/500 mgr. T.R., three of the control cases showed an immediate increase in the number of leucocytes and reached their maximum of about 12,000 with 9,000 polymorphonuclears per c.m.m. of blood by next day. The only other case injected with this dose showed no increase in the number of white blood corpuscles till two days after injection when a slight rise occurred. The maximum was reached on the third day. No negative phase followed injection in this case.

With the exception of the large lymphocytes, the other varieties of white blood corpuscles followed a curve very similar to that of the polymorphonuclear cells. The large lymphocytes showed a considerable relative increase for one day at least, but this rise did not occur on the same day as the increase of polymorphonuclears. The increase in leucocytosis did not last for more than two days.

Leucocytosis of the Insane Cases after Injection.

The seven cases with acute mental symptoms were injected with 1/500 mgr. T.R. In two of these, there was practically no leucocyte reaction. In one case, the reaction was very slight and not beyond ordinary healthy limits. In the other four cases, the number of leucocytes was increased but in no case was the maximum reached on the day following the injection. In two, the maximum leucocytosis was recorded on the second day after injection. In the other two cases, the highest count was obtained on the fifth and sixth days after injection. The curve described by the total leucocytosis is closely followed by all varieties of cells, except in four cases, where there was an increased rise of large lymphocytes. The injection of tuberculin was followed by a negative phase in all the cases. Only one subacute case inoculated with 1/500 mgr. T.R. was examined. There was no effect on the total leucocytosis produced, and the only variety in which any alteration occurred was the large lymphocytes which rose from 1110 per c.m.m. on the day of injection to 1300 per c.m.m. the day following. A marked negative phase followed the injection, but no rise of leucocytes occurred during the succeeding rise in opsonic/

opsonic power. Two chronic cases injected with 1/500 mgr. T.R. were examined for only three days prior to injection. In one of these, the reaction was slight, the rise being complete the day after injection; but, in the other case the rise occurred on the third day, the polymorphonuclear cells numbering 10,000 per c.m.m. of blood. The reaction only lasted two days. Two cases injected with this dose, one acute and one chronic, showed evidences of old tubercular disease. Their curves were very similar. The day after injection, there was a rise of 1000 polymorphonuclear cells followed by a steady fall for four days. The only difference in the leucocyte reaction of the sane and acutely insane after a dose of 1/500 mgr. T.R. is in the reaction time. The insane, as a rule, take longer to react and their maximum leucocytosis is not reached so soon after injection.

Two control cases were injected with 1/750 mgr. T.R. In one case there was no reaction either in the quantity or quality of the leucocytes. The other showed a slight rise in total and also in polymorphonuclear leucocytes,- the maximum being attained next day. There was a rise in the large lymphocytes per c.m.m. the second day after injection.

Of the nine patients, injected with 1/750 mgr. T.R., whose blood was examined, one gave no reaction and two gave only a slight reaction, - the maximum being reached next day. Each of the remaining six cases exhibited a rise of varying amount, but none reached the maximum level before the third day after injection.

The leucocyte reaction following the injection of tuberculin is, therefore, delayed in all forms of insanity. It has been observed also, that after the subcutaneous injection of terebine for therapeutic purposes in the insane, the hyper-leucocytosis induced does not occur till at least forty-eight hours after injection and in some cases seventy-two hours elapse before the maximum leucocytosis is obtained.

There appears to be no marked difference between the various classes of cases examined, as regards either quantity or quality of the leucocytosis produced after injection of tuberculin, except in the large lymphocyte cells which show a considerable relative increase compared with the other varieties and this is especially marked in the more chronic cases. These were, for the most part, cases of adolescent insanity, and Dr. L.C. Bruce has found that this variety of cell is frequently increased in the various forms of insanity occurring at that period of life.

I have not been able to discover any constant

relationship between the total leucocyte curves or that of any special variety of leucocyte, and the opsonic curve after injection.

OBSERVATIONS ON THE URINARY EXCRETION OF THE INSANE CASES BEFORE AND AFTER THE INJECTION OF TUBERCULIN.

The injection of old tuberculin produced constitutional symptoms with rise of temperature and increased metabolism.

I made an attempt to estimate any such change which might occur from the injection of Koch's new tuberculin T.R. For this purpose the urinary excretion of those patients who were confined to bed during the period these observations were being carried on, was collected and examined daily.

A knowledge of the amount and quality of the food taken is necessary before any estimate of the amount of metabolism going on in the body can be arrived at by the examination of the waste products excreted. For this reason the diet of each patient whose urine was collected, was carefully noted and weighed for a week before tuberculin was injected, and for a week thereafter in all cases.

The/

The albumen value of the food taken was estimated from physiological tables compiled by Haig. The urea value of the albumen ingested was fixed at one third of the total albumen as stated by the same author.

The amount of chloride excreted is supposed to have a relationship to the amount of albuminous metabolism taking place in the body. The quantity of chloride ingested in the food and excreted by the urine was also estimated. A specimen of each article of diet was taken and the amount of chloride estimated in a given quantity. A table of the chloride values of all varieties of food given was then drawn up and from this table all chloride estimations were calculated.

The urine excreted by each patient in the twenty-four hours was collected daily. A specimen of the whole twenty-fours collection was examined.

None of the patients received any drugs while these observations were being made.

The urea excreted was estimated in the usual way with hypobromite of soda and Southall's ureometer. The number of grains of urea per ounce of urine, so obtained, was multiplied by the number of ounces of urine passed that day and the total urea excretion estimated.

The/

The amount of chloride excreted was estimated by Mohr's method. Ten c.c. of urine were taken and mixed with 100 c.c. of distilled water. A few drops of chromate of potassium solution were added. The mixture was then titrated with a decinormal solution of nitrate of silver until a pink colour appeared, the mixtures being well stirred during the operation. On the addition of the silver salt, the chlorine combines with the silver, forming a white precipitate of silver chloride. When all the chlorides are precipitated, silver chromate goes down but not while any chloride remains in the solution. Silver chromate is of a red colour, therefore the silver salt was added until a pink colour appeared throughout. To prevent error from the presence of other compounds in the urine, more precipitable than the chromate formed, 1 c.c. was subtracted from the total quantity of decinormal nitrate of silver used. Each c.c. of decinormal nitrate of silver used represents .0058 gramme of sodium chloride. The number of c.c. of decinormal nitrate of silver used multiplied by this figure represents the weight of sodium chloride present in 10 c.c. of urine. The number of grammes of sodium chloride in the total urine excreted per day was then calculated./

calculated.

As the amount of albumen and chloride taken in the food during any one day may not be excreted during the same day, the average daily ingestion and excretion of each was calculated for a week and comparisons of ingestion and excretion are made on the figures so obtained.

The average quantity of fluid taken per day was calculated from the total for the week, as was also the amount of urine excreted.

The ratio of the amount of fluid ingested to the amount of urine excreted remained fairly constant throughout and did not affect the average daily excretion of chlorides.

No albumen or other abnormal constituent appeared in the urine of the cases examined during the time these observations were being made.

Ten cases in all were examined, five of these were classified as suffering from acute mental symptoms and were injected with 1/500 mgr. T.R. Each of these cases showed a loss of weight after injection, varying from 1 to 8 pounds.

The case in whom the maximum loss occurred, suffered from acute mania and had evidences of old tubercular disease of the lung. During the two weeks preceding/

preceding injection she lost three pounds in weight. The same amount of loss occurred during the two weeks succeeding the termination of the observations, while during the intervening two weeks she lost 8 pounds in weight. The loss of weight was, therefore, greater during the two weeks immediately following the injection of tuberculin than during the same period either before or after that event. There was a considerable diminution in the amount of urea excreted after injection in this case. During the week prior to injection the daily average amount of urea excreted had been 28.9 grains greater than the estimated urea value of the food ingested. During the week immediately following the injection of tuberculin, the average daily excretion of urea fell 60 grains, and was 55 grains less per day than the urea value of the food taken for the same period. In the second week after injection, however, the urea excretion reached its former level so that on the daily average, twenty-two grains were excreted in excess of the amount ingested. The excretion of sodium chloride followed a similar curve and while .9 gramme per day was being excreted in excess of ingestion during the week prior to injection, in the succeeding week .75 gramme less per day was excreted than had been taken in as food. During the second

week/

week after injection .78 gramme more than had been ingested was excreted. There was no increased restlessness or marked exacerbation of mental symptoms to account for the increased loss of weight after injection.

One of the cases lost two pounds during the two weeks following the injection of 1/500 mgr. T.R. and showed no further loss of weight during the succeeding weeks. In this case the excretion of urea increased after injection but not in proportion to the increased amount of albumen ingested. Before injection, the excretion of urea per day exceeded the urea value of the food taken by 12 grains. In the course of the following two weeks, although there was an increase in the output of urea, there was a daily average diminution in the amount excreted, compared with the amount of ingested, of four and sixteen grains per day during each of these weeks. There was a slight fall after injection in the excess of chlorides excreted over the amount ingested.

Two of the five cases injected with 1/500 mgr. T.R. showed an increased excretion of urea as compared with the elimination before injection. One of these patients, who suffered from melancholia, lost 1 pound in weight during the week before injection, but lost five /

five pounds in the following two weeks. Before injection, the average output of urea per day was less than the average amount taken in the food by 21 grains. The week after injection, 20 grains per day in excess of the amount ingested were excreted. During the second week after injection ingestion and excretion of urea practically balanced each other. There was no increased output of urea as compared with intake during the three weeks over which the observations extended. This patient gained 3 pounds in weight during the week after the observations were concluded. The other case, who showed an increased output of urea, only lost 1 pound in weight. The urine was lost during the second week but in that time there was a further loss in weight of one pound. Before injection, the excretion of urea per day was 20 grains less than the amount ingested. While the amount ingested was the same during the following week, the quantity excreted per day increased and exceeded the value ingested by 40 grains. The excretion of chlorides also increased so, that, while before injection, excretion was slightly less than ingestion, the following week excretion slightly exceeded the amount taken in.

In/

In the fifth case injected with 1/500 mgr. T.R. the average output of urea per day, for the week preceding injection, was 52 grains in excess of ingestion. No alteration occurred during the succeeding week. There was a marked increase in the excretion of chlorides, however, for while there was no alteration in the amount ingested during the weeks before and after injection, the excretion increased during the latter week, so that the excess over ingestion was raised from .86 gramme per day to 4.34 grammes per day.

In all the five cases injected with 1/500 mgr. T.R. a loss in weight occurred during the week immediately following injection.

After injection, two cases showed an increased excretion of urea as compared with the urea value of the food taken. Two showed a diminution, while one showed no change in the relative amounts ingested and excreted.

Two cases showed an increased excretion of chlorides as compared with the amount ingested. Two showed a diminution, while in one case no change was observed.

No definite result can, therefore, be arrived at as to the effect produced on the metabolism of insane patients by the injection of 1/500 mgr. of tuberculin.

Five of the cases whose urine was examined, received an injection of 1/750 mgr.T.R.

Three of these were cases of general paralysis and in none of them was any alteration in weight recorded while under observation. In all three cases during the week prior to injection the average daily excretion of urea was greater than the urea value of the food ingested. In two of the cases during the week preceding the injection the daily excretion was a few grains less than the estimated amount ingested; but, in the course of the following week, the daily output was greater than the amount taken in. Both of these patients had formerly suffered from tubercular disease of the lung. In the third case of general paralysis examined, the excess of urea excreted per day was slightly increased. In all three cases, before injection, the daily excretion of chloride was less than the estimated amount ingested. This difference between excretion and ingestion was increased during the first week following injection.

The other two patients injected with 1/750 mgr. T.R., during the week before injection, were excreting more urea per day than the estimated amount ingested. During the following week, the excess of urea excreted over the urea value of the food ingested per day was increased./

increased. Before injection both were excreting less chloride than they were ingesting. In the course of the succeeding week in one case the difference between intake and output was increased, while in the other, the daily excretion of chloride exceeded the amount estimated to have been taken in the food. This latter case gained 3 pounds in weight during the week following injection but this may have been due to rest in bed. The other case gained 2 pounds in the same time.

All three cases with evidence of former lung disease had a diminished daily excretion of both urea and chlorides, after the injection of tuberculin, compared with the amount of each ingested.

No very definite conclusions can be drawn from these observations.

OBSERVATIONS ON THE MENTAL SYMPTOMS PRODUCED IN THE INSANE AFTER THE INJECTION OF TUBERCULIN.

It has been frequently noted that an acute fever, a local inflammation, a crop of boils, a septic poisoning, has cut short and even cured attacks of insanity. To obtain the same results severe blistering was formerly resorted to. The treatment of insanity by the administration of large doses of thyroid extract, as recommended by Dr. Bruce, produces very much the same results, while the remedy is under the control of the physician using it. Wagner of Vienna got very beneficial results in many cases of insanity by giving large doses of Koch's old tuberculin.

The doses of both remedies used produced constitutional symptoms such as, rise of temperature, increased pulse rate, and sweating, in all the cases where benefit resulted from the treatment. The production of fever with increased metabolism would therefore seem to be the cause of the improvement and not the specific action of the drug. The mental symptoms were noted in all the cases injected with tuberculin by me.

There was no difference produced in the mental state of any of the patients injected with 1/750 mgr. T.R./

T.R.

Seven acute cases were injected with 1/500 mgr. T.R. In two, no mental effect was produced. Three cases showed aggravated mental symptoms. One of these on admission had been restless, noisy, singing snatches of songs, or talking almost continuously. Her remarks were quite incoherent. She had no interest in what went on around her, was lacking in attention, and her habits were defective. Before injection, she had been quieter, resting in bed, and not noisy. She could tell her name when asked. The day after injection with 1/500 mgr. T.R. she was noisy, singing and talking by turns, rolling about in bed, and paid no attention to what was said to her. She could not give her name and was absolutely incoherent. This condition lasted two days when she became quieter and passed back to the condition she was in before inoculation. One case of mania with confusion was brighter and more talkative on the day following injection, but next day was again confused. A third case was irritable, inclined to be impulsive, obstinate and sullen after injection. During the days preceding the injection she had been quieter and more contented than since her admission.

Two melancholic cases showed signs of mental improvement/

inprovement after injection. One of them,who had not spoken for days before injection,spoke quite clearly and answered questions, though slowly, the day following injection. The second day she was not quite so bright, and by the third day had relapsed to the condition she was in prior to injection.

The other case of melancholia occupied a corner bed in the ward. She lay with her face to the wall, refusing to speak, and wept at times. She resisted all movement. The day after being injected she sat up in bed and answered questions slowly and in a very low voice. The improvement did not persist in this case for longer than four days.

One sub-acute case injected with 1/500 mgr. T.R. showed a mental reaction. This patient had been resident in the asylum for over a year. She suffered from acute mania on admission. Before injection, she showed marked symptoms of mental enfeeblement. Her movements were slow, her sensibility dulled, and her mental reaction delayed. Her emotions were blunted and she hardly spoke to her children when they visited her. The day following injection she was brighter, talked more freely, and was more acute mentally. The next day she was more talkative and passed/

passed remarks on anything which attracted her attention. She did not sleep well, however, that night, was restless, getting out of bed, and she had hallucinations of sight and hearing. She developed delusions of identity, recognising in some members of the staff of the Institution old acquaintances, and talked to them of incidents which had occurred years before but of which they knew nothing. The delusions persisted for a few days, although the patient became less talkative, and by the eighth day after injection was in practically the same mental condition as before inoculation.

The dose administered was not sufficient to produce any rise of temperature or increase of pulse rate. Neither did it cause any constitutional symptoms, and the mental effects produced by the injection were neither definite nor lasting.

SUMMARY AND CONCLUSIONS.

1. That the average tuberculo-opsonic index in persons free from tubercular disease varied between .97 and 1.32.

2. That the tuberculo-opsonic index of persons free from tubercular disease varied considerably from day to day, but that the weekly average of the tuberculo-opsonic index in the same persons varied very little from week to week.

3. That the average tuberculo-opsonic index in 30 insane persons, all free from symptoms of active tubercular disease, was .88 , the variation being between .65 and 1.23.

4. That the daily variation in the tuberculo-opsonic indices of insane persons is much greater than in healthy persons.

5. The result of these observations leads me to conclude that the insane, as a class, are more liable to tubercular infection than the healthy sane population.

6. That the tuberculo-opsonic indices of the insane classified/

classified according to their length of residence in the asylum, is .92 in those patients who had been in residence for more than one year, as against .82 in those who had been in residence under a year. From which I conclude that asylum residence does not predispose the insane to tubercular infection.

7. That the tuberculo-opsonic indices of the insane, classified according to their mental state, viz., acute, sub-acute, and chronic, indicate most clearly that the acutely insane with an average index of .87 are more liable to tubercular infection than the chronic cases who had an average index of .93.

8. That the low tuberculo- opsonic index of cases of general paralysis, namely .79, explains the frequent occurrence of tubercular disease in this class of patient.

9. That the tuberculo-opsonic index of the acutely insane patients, classified according to the form of their mental disease, is lower in cases of adolescent insanity than in adult cases suffering from mania and melancholia. The adolescent index being .84 as against .89 in the adult cases.

10./

10. That the tuberculo-opsonic indices of cases of melancholia in adults is .88 as against an index of .91 in adults suffering from mania.

11. As the result of observations 9 and 10, I conclude that the acutely insane adolescent is more prone to contract tubercular disease than the acutely insane adult, and that adults suffering from melancholia are more liable to tubercular infection than adults suffering from mania.

12. That an injection of 1/500 mgr. T.R. in healthy sane persons produced a negative reaction in 2 out of 4 cases. As I have no reason to suppose that these two controls who gave a negative reaction were tubercular, I believe 1/500 mgr. T.R. is too large a dose to use for diagnostic purposes.

13. That out of 12 insane persons injected with 1/500 mgr. T.R., 11 gave a negative reaction to the tubercle bacillus from which I conclude that the insane as a class have a low resistive power to tubercular infection.

14. That the reaction after injection in the insane persons who gave a negative reaction was more prolonged than in the healthy sane persons.

15./

15. That the negative phase induced by injection with 1/500 mgr. T.R. in the acute insane cases, was more marked than in the chronic insane cases and that the succeeding positive phase was more delayed. From this observation, I conclude that the acutely insane have a lower resistive power to tubercular toxaemia than the chronic cases.

16. That so large a proportion as 91 per cent of the insane patients gave a negative reaction after injection with 1/500 mgr. T.R. is probably due to the dose being too large for diagnostic purposes.

17. That out of 18 insane patients injected with 1/750 mgr. T.R. only 4 or 22.2 per cent, gave a negative reaction.

18. That the remaining 14 cases in this series injected with 1/750 mgr. T.R. although they showed no negative reaction, reacted much more slowly than the two control cases injected with the same dose.

19. That although an injection of 1/750 mgr. T.R. is probably a sufficiently small dose for diagnostic purposes in the healthy sane population, it is still too large a dose for diagnostic purposes/

purposes in insane persons.

20. That in estimating the occurrence or absence of a negative phase after injection with T.R. it is necessary to take into consideration the variations in the tuberculo-opsonic indices for at least five days prior to injection.

21. That in both the sane and the insane persons who gave a negative phase after injection, it was noted that the tuberculo-opsonic indices, prior to injection, showed greater daily variation than in those who gave no negative phase.

22. That I could discover no connection between the level of the tuberculo-opsonic index on the day of injection and the subsequent presence or absence of a negative phase.

23. That, as no constitutional symptom or disagreeable effect occurred in any of the persons injected with either 1/500 or 1/750 mgr. T.R., such doses of tuberculin can be administered with perfect safety at all events in persons without active symptoms of tubercular disease.

24. That the opsonic indices of sane persons to the bacillus coli, staphylococcus aureus, and micrococcus rheumaticus, closely resemble the tuberculo-opsonic index.

25./

25. That the opsonic indices of 12 insane patients tested to the bacillus coli, staphylococcus aureus, and micrococcus rheumaticus closely resembled the opsonic indices of the sane persons examined, with the exception of the opsonic indices of the insane patients to the micrococcus rheumaticus, which was lower in the insane than in the sane persons.

The daily variation of the indices of the insane patients to all these organisms was greater than the daily variation of the indices of the sane persons.

26. That, as the result of injecting 1/500 mgr. T.R., both the sane and insane persons frequently gave negative phases to one or other of these organisms, but that the percentage of negative phases so resulting was much greater in the insane than in the sane persons.

27. That, as the result of injecting 1/750 mgr. T.R. in three insane persons and in one control case, two of the insane persons and the control case showed negative phases to one or all of the three organisms, bacillus coli, staphylococcus aureus and micrococcus rheumaticus.

28./

28. It is reasonable, therefore, to conclude that a general fall may occur in the opsonic power of the blood of a person who has been injected with T.R., but that this fall is more marked in the insane than in sane persons.

29. That beyond a slight increase of pulse rate, there were no constitutional symptoms as the result of injecting either a 1/500 or 1/750 mgr. T.R. in either the sane or the insane persons.

30. Five of the ten insane persons whose weight was recorded, lost weight after injection. That as the result of injecting tuberculin in both the sane and insane, there was a very general increase in the leucocytosis. The reaction being more rapid in the sane than in the insane persons. The large lymphocyte cells were the variety of leucocyte most commonly increased as the result of injection. No connection was traced between the curve of the opsonic index and the curve of the leucocytosis.

31. No definite conclusions can be drawn from the result of the observations made on the excretion of chloride and urea in the urine as the result of the injection of tuberculin.

32. Changes in the mental state, after the injection of tuberculin, were indefinite.

APPENDIX GIVING DETAILS OF SOME OF THE WORK DONE, WHICH IS SHOWN IN THE FORM OF TABLES.

TABLE DESCRIBING THE CASES EXAMINED.

Case	Sex	Age	Duration of Residence.	Physical Condition.	Original Mental Disease.	Present State.
No.1	M.	48	One month	Healthy	General Paralysis.	Demented.
No.2	F.	17	Two months	Healthy	Hebrephrenia	Confused, noisy, restless, dirty.
No.3	F.	42	Three months	Healthy	Melancholia	Apprehensive. Hallucinations of hearing.
No.4	F.	38	Three months	Healthy	Melancholia	Depressed and apprehensive.
No.5	F.	38	Three months	Old tubercular disease.	Acute mania	Confused, noisy, obstinate, hallucinations of taste and smell.
No.6	F.	21	Three months	Healthy	Hebephrenia	Demented and impulsive.
No.7	F.	16	Six months	Healthy	Katatonia	Demented and depressed.
No.8	M.	29	Six months	Healthy	General Paralysis.	Demented.
No.9	F.	29	Nine months	Healthy	Delusional Insanity	Delusions of persecution.
No.10	M.	51	Eleven months	Old tubercular disease.	General Paralysis.	Entering the third stage.
No.11	F.	32	Eighteen months	Healthy	Katatonia	Stuporose.
No.12	M.	52	one year	old tubercular disease	General Paralysis.	Entering the third stage.
No.13	F.	36	one year	Healthy	Delusional Insanity	Delusions of grandeur.
No.14	F.	39	one year	Healthy	Katatonia	With mania and mental confusion.
No.15	M.	43	1½ years	Healthy	Melancholia	Sub-acute. Hallucinations of hearing.

Continued:-

TABLE DESCRIBING THE CASES EXAMINED.

Case	Sex	Age	Duration of Residence	Physical Condition.	Original Mental Disease	Present State.
No.16	F.	43	1½ years	Healthy	Mania	Considerable mental enfeeblement.
No.17	M.	40	2 years	Healthy	Katatonia	Stuporose for several years.
No.18	F.	29	2½ years	Cicatrices in neck.	Katatonia	Enfeebled, liable to excited attacks.
No.19	F.	29	2½ years	Healthy	Hebephrenia	Demented, restless, untidy.
No.20	M.	35	3 years	Healthy	Delusional Insanity.	Suspicious, delusions of persecution.
No.21	M.	27	3 years	old tubercular disease.	Katatonia	Demented, habits defective.
No.22	F.	46	3 years	Healthy	Acute Mania	Recurrent attack, not enfeebled.
No.23	F.	28	3¾ years	Healthy	Hebephrenia	Impulsive, much enfeebled.
No.24	F.	25	4 years	Healthy	Mania	Demented, dirty, destructive.
No.25	F.	21	4 years	Healthy	Katatonia	Stuporose for 3 years.
No.26	F.	32	5 years	Healthy	Katatonia	Completely demented.
No.27	F.	32	5 years	Healthy	Hebephrenia	Demented, liable to impulsive attacks.
No.28	F.	28	7 years	Healthy	Mania	Demented, habits untidy.
No.29	F.	29	8 years	Healthy	Hebephrenia	Demented, liable to impulsive attack
No.30	M.	28	11 years	Healthy	Katatonia	Demented, habits defective.

TABLE SHOWING THE AVERAGE INDICES OF THE CONTROL CASES TO THE VARIOUS ORGANISMS EMPLOYED BEFORE THE INJECTION OF TUBERCULIN.

Case.	Tubercle Bacillus.	Bacillus Coli	Staphyl. Aureus.	Micrococcus Rheumaticus.
A.	.98	1.07	1.09	1.22
B.	.97	.84	1.45	.89
C.	1.32	1.03	.9	1.05
D.	1.06	1.02	1.19	1.14
E.	1.01			
F.	1.11	1.14	.89	1.05
Average	1.07	1.02	1.10	1.07.

TABLE SHOWING DAILY TUBERCULO-OPSONIC INDEX OF CONTROL CASES BEFORE AND AFTER INJECTION OF 1/500 mgr. T.R.

A.	B.	C.	D.
.68	1.04	1.21	1.13
.75	.93	1.46	1.02
1.04	.88	1.25	1.22
1.11	1.18	1.42	1.02
1.36	.82	1.28	.93
Injection given.			
.74	.85	1.13	1.04
.59	.92	.71	.95
.62	.88	.63	.92
.91	.82	.79	
.97	.98	1.12	
1.57	.9	1.74	
1.26	.98	1.81	
	1.32		

TABLE SHOWING AVERAGE TUBERCULO-OPSONIC INDICES OF THE VARIOUS CLASSES OF INSANE PATIENTS BEFORE INJECTION.

ACUTE CASES.		SUBACUTE CASES.		CHRONIC CASES.		GENERAL PARALYTICS.	
Case 2.	.87	Case 9.	.83	Case 18.	1.03	Case 1.	.78
" 3.	.68	" 11.	.84	" 19.	.78	" 8.	.78
" 4.	1.08	" 13.	.74	" 21.	.93	" 10.	.96
" 5.	.84	" 14.	1.06	" 23.	1.07	" 12	.65
" 6.	.86	" 15.	.75	" 24.	.74		
" 7.	.81	" 16	.86	" 25.	.9		
" 22.	.95	" 17	.96	" 26.	.99		
		" 20	.9	" 27.	.93		
				" 28.	.85		
				" 29.	1.23		
				" 30.	.78		
Average Index.	.87		.86		.93		.79

TABLE SHOWING DAILY TUBERCULO-OPSONIC INDICES OF FIFTEEN INSANE PATIENTS BEFORE AND AFTER INJECTION OF 1/750 mgr. T.R.

Case 1.	Case 8.	Case 10.	Case 11.	Case 12.	Case 13.	Case 14.	Case 15
.68	.68	.84	.7	.7	.62	1.12	.76
.62	.88	1.08	.96	.56	.82	.87	.88
.82	.86	.77	.83	.61	.74	1.07	.63
.81	.78	1.1	.84	.71	.61	1.21	.78
1.	.7	1.05	.91	.7	.81	1.04	.7
Injected							
1.3	.7	.86	1.07	.7	.75	.81	.8
1.28	.8	.86	.9	.88	.75	1.03	1.03
1.11	1.02	1.15	.91	1.16	.85	1.44	1.32
1.08	.88	1.09	1.08	.8	1.	1.34	.8
	.79		1.13	.93	1.23	1.	1.03

Case 18	Case 19	Case 23	Case 24.	Case 26.	Case 27.	Case 30.
.93	.77	1.06	.75	.94	.96	.68
1.16	.95	1.08	.54	.96	.87	.58
1.07	.77	1.	.75	1.11	.75	.67
.84	.68	1.	.67	1.15	.91	.93
1.16	.75	1.25	1.	.83	1.2	1.04
Injected						
1.03	1.07	1.05	1.	1.02	.93	1.13
1.06	1.22	.97	1.28	1.1	1.38	1.38
.94	1.27	.98	1.26	1.16	.94	.94
1.46	1.58	.76	1.06	1.49	1.06	1.06
	1.03	1.15		1.01		
		1.38				

TABLE SHOWING DAILY OPSONIC INDICES OF FOUR CONTROL CASES TO THE BACILLUS COLI COMMUNIS. STAPHYLOCOCCUS AUREUS AND MICROCOCCUS RHEUMATICUS BEFORE AND AFTER THE INJECTION OF 1/500 mgr. T.R.

CASE A.

Bacillus Coli communis.	Staphylococcus Aureus	Micrococcus Rheumaticus.
.91	1.11	1.4
1.04	1.08	1.6
.92	1.04	1.21
1.52	.98	.9
1.	1.24	1.03
Injected		
.54	1.22	1.4
.71	.9	.69
.93	1.07	.79
1.07	.78	1.32
1.08	1.02	1.14
1.28		1.05

CASE B.

Bacillus coli Communis	Staphylococcus Aureus.	Micrococcu Rheumaticus
.92	1.62	.82
.9	1.48	1.
.81	1.63	.96
.71	1.42	.9
.9	1.11	.8
.81	.82	1.
.63	.63	1.17
.69	1.14	.95
1.2	1.24	.89
1.06	1.	1.06
1.	1.07.	

CASE C.

1.12	.9	1.4
1.23	1.06	1.13
.91	.8	.86
.85	.82	1.2
1.06	.94	.69
Injected		
1.07	1.	.74
1.31	.83	1.26
1.2	1.26	.96
1.3	1.08	.86
.93	.9	1.09
1.33	1.05	1.26

CASE D.

1.	1.21	1.08
1.09	1.2	1.05
1.14	1.13	1.3
1.07	1.13	1.23
.81	1.3	1.04
.63	1.46	.75
.85	1.	.65
1.18	1.02	.8

TABLE SHOWING DAILY OPSONIC INDICES OF CONTROL CASE F. TO THE VARIOUS ORGANISMS EMPLOYED BEFORE AND AFTER INJECTION WITH 1/750 mgr. T.R.

Tubercle Bacillus.	Bacillus Coli.	Staphylococcus Aureus.	Micrococcus Rheumaticus.
1.38	1.46	.98	1.06
1.4	1.29	.84	.93
1.1	1.15	.93	.82
1.33	.92	1.08	1.4
1.14	.9	.66	1.04
Injected			
1.38	.92	1.17	1.27
1.36	1.12	.72	.94
.93	1.04	.67	.5
1.03	1.11	.93	.81

TABLE SHOWING THE AVERAGE OPSONIC INDICES OF THE ACUTE CASES TO THE VARIOUS ORGANISMS EMPLOYED BEFORE INJECTION.

Before injection.

Case.	Tubercle Bacillus.	Bacillus Coli.	Staphylococcus Aureus.	Micrococcus Rheumaticus.
2	.87	.81	.91	
3	.68	.93	1.08	.91
4	1.08	1.12	1.07	1.
5	.84	1.	.95	.79
6	.86		1.06	
7	.81		.91	
22	.95		1.13	
Average	.87	.96	1.01	.9

TABLE SHOWING THE AVERAGE OPSONIC INDICES OF THE SUBACUTE AND CHRONIC CASES TO THE VARIOUS ORGANISMS EMPLOYED, BEFORE INJECTION.

Cases	Tubercle Bacillus	Bacillus Coli Communis	Staphylococcus Aureus	Micrococcus Rheumaticus.
No.9	.83	1.01	.93	1.21
" 16	.86	.93	1.23	.78
" 17	.96	1.17	1.38	.92
" 20	.9	1.1	.91	1.17
" 21	.93	.95	1.05	.93
" 25	.9	1.07	1.09	1.07
" 28	.85	1.01	1.16	.86
" 29	1.23	1.28	1.23	.78
Average	.93	1.06	1.12	.96

Table showing the number of negative phases to the Tubercle Bacillus, Bacillus Coli Communis, Staphylococcus Aureus and Micrococcus Rheumaticus following the Injection of a 1/500 mgr. T.R. in the Control and Insane Cases.

Controls	Tubercle Bacillus	Bacillus Coli Communis.	Staphylococcus Aureus.	Micrococcus Rheumaticus.
A.	N.	N.	N.	N.
B.	O.	N.	N.	O.
C.	N.	O.	N.	O.
D.	O.	N.	N.	O.
Case. 2	N.	N.	N.	
3	N.	N.	O.	O.
4	N.	N.	N.	N.
5	N.	N.	O.	N.
6	N.		N.	
7	N.		N.	
22	N.		O.	
9	O.	N.	N.	N.
16	N.	N.	O.	N.
21	N.	N.	N.	O.
25	N.	N.	N.	N.
28	N.	N.	N.	O.

TABLE SHOWING DAILY OPSONIC INDICES TO ALL THE ORGANISMS EMPLOYED IN TWO ACUTE AND TWO CHRONIC INSANE PATIENTS INJECTED WITH 1/500 mgr. T.R.

ACUTE CASES.

CASE 4

Tubercle Bacillus	Bacillus Coli.	Staphylo-coccus Aureus.	Micro-coccus Rheu.
.84	1.62	.98	1.5
1.1	.66	1.03	1.2
1.04	1.09	1.61	1.1
1.39	1.14	.7	.79
.95	1.12	1.05	.62
Injected			
.9	1.14	1.18	.76
.9	1.	.68	.69
.73	1.17	.7	1.04
1.06	1.22	.86	.61
1.1	1.33	.44	.8
1.36	1.42	1.03	.79
1.6			

CASE 3.

Tubercle Bacillus	Bacillus Coli.	Staphylo-coccus Aureus.	Micro-coccus Rheu.
.58	.9	.81	.6
.73	.91	.96	.82
.8	.72	1.13	.92
.62	1.06	1.21	1.16
.68	1.06	1.33	1.08
.59	.83	1.24	1.25
.69	.85	1.35	1.25
.86	.92	1.39	.9
1.	.97	1.23	1.35
1.06			
1.31			

CHRONIC CASES.

CASE 9

.72	1.18	.88	1.37
.8	1.18	.75	1.41
.89	.96	1.35	1.12
.93	.94	.92	1.18
.81	.81	.78	1.
Injected			
.89	.66	.7	.6
.89	.87	.79	.85
.88	.78	.88	.71
1.05	1.	.7	.78
1.17	1.	.79	1.06
1.14	1.33		1.07

CASE 21.

.9	.93	1.31	.87
.6	1.04	1.25	1.
.84	.93	1.22	1.25
1.16	.88	.91	.9
1.15	1.	.67	.66
.86	.6	.57	.66
.81	.68	1.03	.92
1.11	.85	1.	.76
1.16	1.	.97	.68
1.35	1.2	.91	1.02
1.26	1.44		.84

TABLE SHOWING DAILY OPSONIC INDICES OF THREE INSANE CASES TO THE VARIOUS ORGANISMS EMPLOYED BEFORE AND AFTER INJECTION WITH 1/750 mgr. T.R.

Tubercle Bacillus	CASE 17. Bacillus Coli.	Staphylo-Aureus.	Micro-Rheumat.	Tubercle Bacillus	CASE 20. Bacillus Coli.	Staphylo-Aureus.	Micro. Rheumat.
1.	1.48	1.56	.59	.83	1.15	.76	.95
1.04	1.11	1.38	.53	1.13	1.11	1.04	1.26
.93	.92	1.36	.92	.94	1.06	1.14	.85
.85	1.06	1.2	1.04	.72	1.21	.92	1.63
1.	1.42	1.4	1.55	.9	1.	.71	1.18
Injected							
1.04	.93	.99	1.43	.86	1.09	1.28	1.41
1.06	.95	1.34	.82	1.2	1.	1.09	1.43
1.07	1.07	1.22	.93	.8	.93	.87	.93
1.3	.93	.95	1.12	.98	.88	1.04	1.12

CASE 29.

Tubercle Bacillus	Bacillus Coli.	Staphylococcus Aureus.	Micrococcus Rheumaticus.
1.42	1.35	1.37	.73
1.18	1.4	1.27	.81
1.	1.23	1.1	.81
1.43	1.22	1.32	.6
1.14	1.2	1.09	.95
Injected			
1.22	1.14	1.07	1.
1.63	1.06	1.3	1.06
1.4	1.36	.87	1.
1.	1.26	1.19	1.06

Table showing Quantitative and Qualitative Leucocytosis per c.m.m. of blood of two Control Cases before and after Injection of 1/500 mgr. T.R.

CASE A.

Total Leucocytosis.	Polymorpho-nuclear cells.	Small Lymphocytes.	Large Lymphocytes.	Eosinophile cells.	Mast-cells.
7634	4734	1638	1144	118	
6332	3858	1893	509	72	
7808	3333	2840	1484	151	
4988	2871	1092	732	293	28
6733	4446	1936	313	38	57
Injected					
12508	9671	855	1699	283	
10239	6075	2449	1620	90	45
6493	4122	1170	1064	137	30
6744	4294	1511	877	62	
5453	3448	1035	909	31	30

CASE B.

7904	4104	3360	336	80	24
7660	3704	3397	559		
6988	3892	2422	602	70	
8695	4560	3294	572	199	25
8641	4447	3728	364	51	51
Injected					
7652	3835	3321	429	45	22
9990	5400	3600	800	160	30
11386	6010	3175	1961	147	33
11557	5226	4481	853	74	21
7653	3804	3344	483	22	

Table showing Quantitative and Qualitative Leucocytosis per c.m.m. of blood of One Acute and one Chronic Insane Patient before and after the Injection of 1/500 mgr. T.R.

CASE 2.

Total Leucocytosis.	Polymorpho-nuclear cells.	Small Lymphocytes.	Large Lymphocytes.	Eosinophile cells.	Mast cells.
10614	6113	3585	810	106	
12967	7969	3510	1079	409	
8329	5754	2110	417	24	24
7330	4499	2422	220	146	43
8962	5607	2844	477	54	
Injected.					
10338	5893	2171	2119	155	
10338	5170	3825	1085	258	
8991	6750	1647	450	144	
12974	7579	4498	728	169	
12276	7934	3405	740	197	

CASE 25.

19300	14400	2800	1980	120	
15968	10448	4368	784	368	
13511	9071	2974	960	173	133
Injected					
12974	9308	2678	728	260	
11314	7934	1925	1764	691	
24950	19150	3650	1650		500
16190	11921	3539	2054	476	200
10648	6722	2454	1195	277	

Table showing Quantitative and Qualitative Leucocytosis per c.m.m. of Blood of Two cases of Chronic Mental Disease before and after the injection of 1/750 mgr T.R.

CASE 29.

Total Leucocytosis.	Polymorpho-nuclear cells.	Small Lymphocytes.	Large Lymphocytes.	Eosinophile cells.	Mast cells.
6647	4155	1774	593	86	39
4985	3265	1380	310		30
8081	5220	2250	1467	144	
5661	3582	1561	469	16	33
7222	3907	2517	660	95	43
Injected					
10328	5821	2791	1375	341	
6499	3276	2431	585	189	18
5844	2959	1815	763	307	
4890	2380	1750	600	130	30

CASE 30.

5664	3678	1200	660	78	48
7186	4750	1302	420	672	42
10647	6754	2379	1237	277	
9326	6967	1429	686	149	93
7325	4301	1857	778	389	
Injected					
9970	6260	2260	930	360	160
10988	7293	2343	1056	220	66
11627	7352	2170	1505	420	180

Table showing the Daily Averages of the Value in Urea and Sodium Chloride of the Food ingested and the Daily Average Amounts of each excreted in the Urine by Five Insane Patients during the week preceding and during the two weeks immediately following the Injection of 1/500 mgr. T.R.

CASE 2.

	UREA IN GRAINS.			SODIUM CHLORIDE IN GRAMMES.		
	Week preceding injection	First week after injection	Second week after injection.	Week preceding injection	First week after injection	Second week after injection
Ingestion	264.9	260	Urine lost	3.	3.	Urine lost
Excretion	240.	300		2.9	3.5	
		Loss of Weight 1 pound.				

CASE 3.

Ingestion	260	266	267.6	3.1	3.	4.1
Excretion	239	286	268.1	3.5	3.4	4.3
		Loss of Weight 5 pounds.				

CASE 4.

Ingestion	242	259	316	2.6	3.3	4.8
Excretion	254	253	302	6.31	4.25	5.5
		Loss of Weight 2 pounds.				

CASE 5.

Ingestion	230.8	248.1	241.4	3.5	4.4	4.54
Excretion	259.7	193	263	4.4	3.65	5.32
		Loss of Weight 8 pounds.				

CASE 6.

Ingestion	260	266	267.6	3.1	3.	4.1
Excretion	239	286	268.1	3.5	3.4	4.3
		Loss of Weight 5 pounds.				

Table showing the Daily Averages of the Value in Urea and Sodium Chloride of the Food ingested and the Daily Average Amounts of each excreted in the Urine by Five Insane Patients - three being General Paralytics - during the week preceding and during the Two weeks immediately following the Injection of 1/750 mgr. T.R.

CASE 1.

	UREA IN GRAINS.			SODIUM CHLORIDE IN GRAMMES.		
	week preceding Injection.	First week after injection.	Second week after injection.	Week preceding injection.	First week after injection.	Second week after Injection.
Ingestion	283.4	295.9	310	21.46	23.7	23.79
Excretion	424.5	442.9	400	16.87	15.4	13.56
	No change in Weight.					

CASE 10.

Ingestion	326	393	296.5	24	25	23
Excretion	379	334	335.3	16	14	15
	No change in Weight.					

CASE 12.

Ingestion	317	371.6	376	24.15	25.1	24.7
Excretion	372	365	388	17.1	16.1	15.2
	No change in Weight.					

CASE 14.

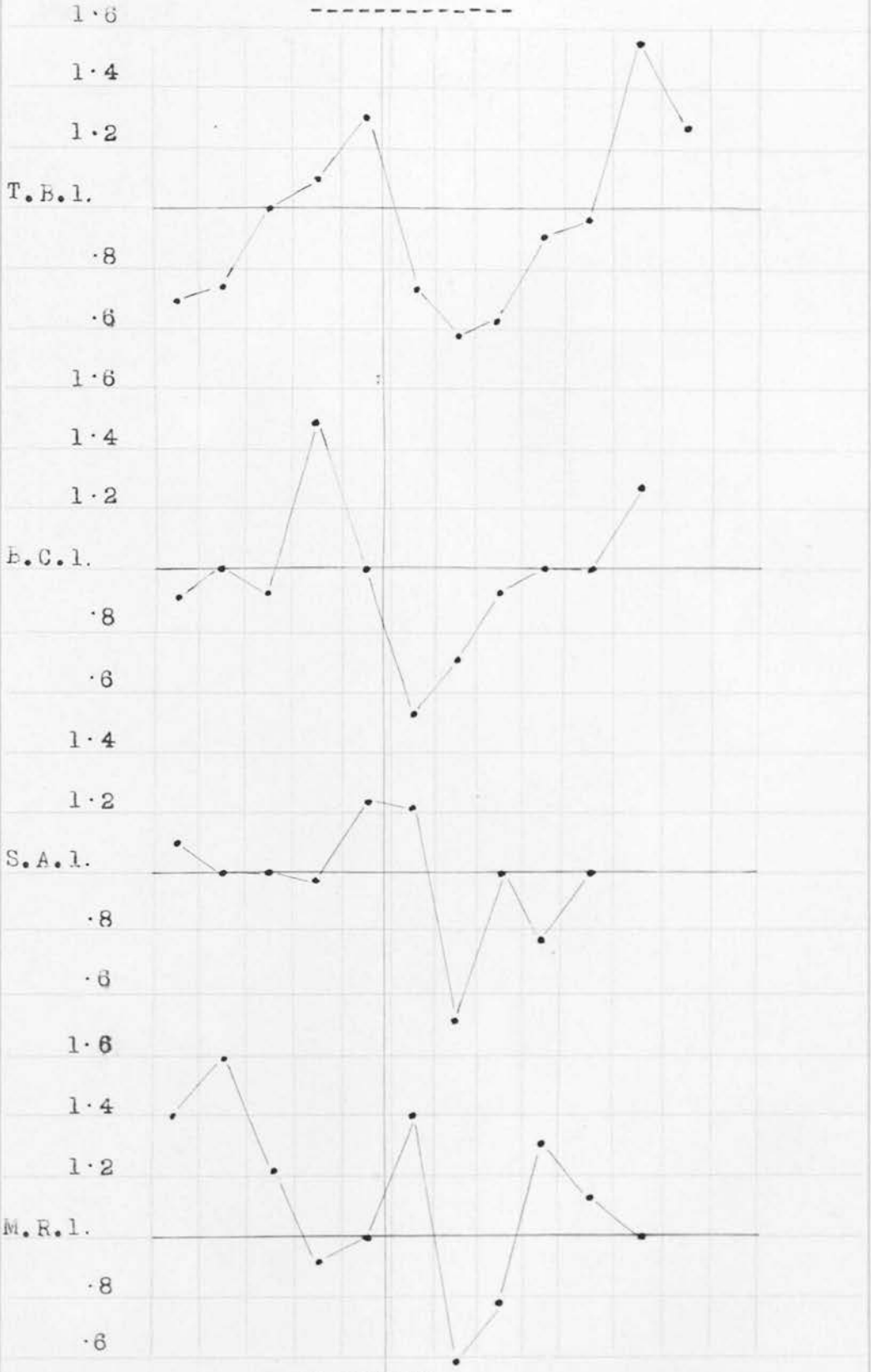
Ingestion	183	182	Urine lost	10.7	11	Urine lost.
Excretion	140	250		9.7	9.5	
	Gain in Weight 3 pounds.					

CASE 29.

Ingestion	169	182	161	10	10	9.9
Excretion	153	222	259	9	11.8	11.7
	Gain in Weight 2 pounds.					

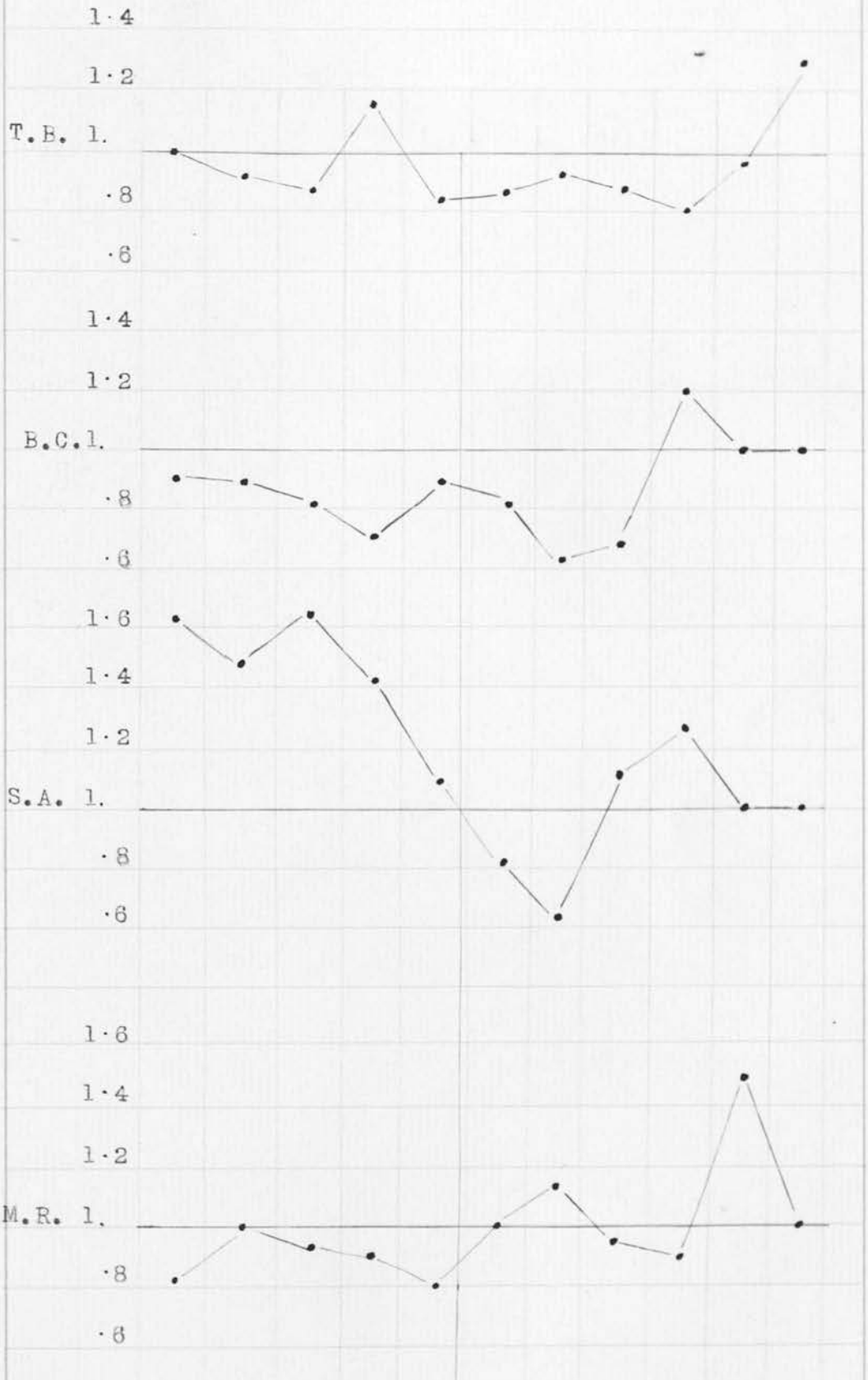
CHARTS SHOWING DAILY OPSONIC INDICES
TO THE TUBERCLE BACILLUS, BACILLUS COLI COMMUNIS
STAPHYLOCOCCUS AUREUS & MICROCOCCUS RHEUMATICUS
BEFORE & AFTER THE INJECTION OF 1/500 mgr. T. R.

CONTROL CASE A.



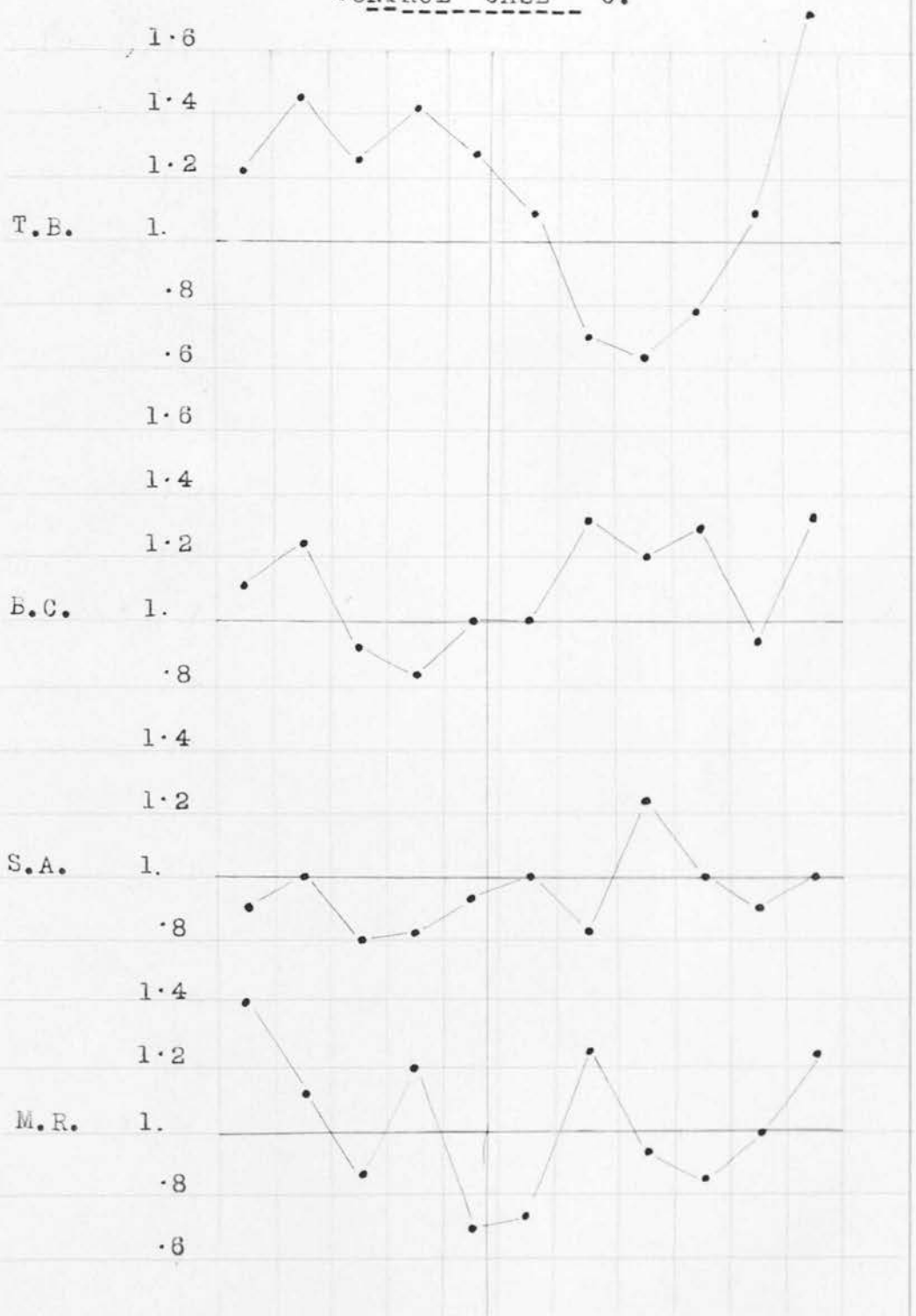
CHARTS SHOWING DAILY OPSONIC INDICES TO THE TUBERCLE BACILLUS, BACILLUS COLI COMMUNIS, STAPHYLOCOCCUS AUREUS & MICROCOCCUS RHEUMATICUS BEFORE & AFTER THE INJECTION OF 1/500 mgr. T.R.

CONTROL CASE B.



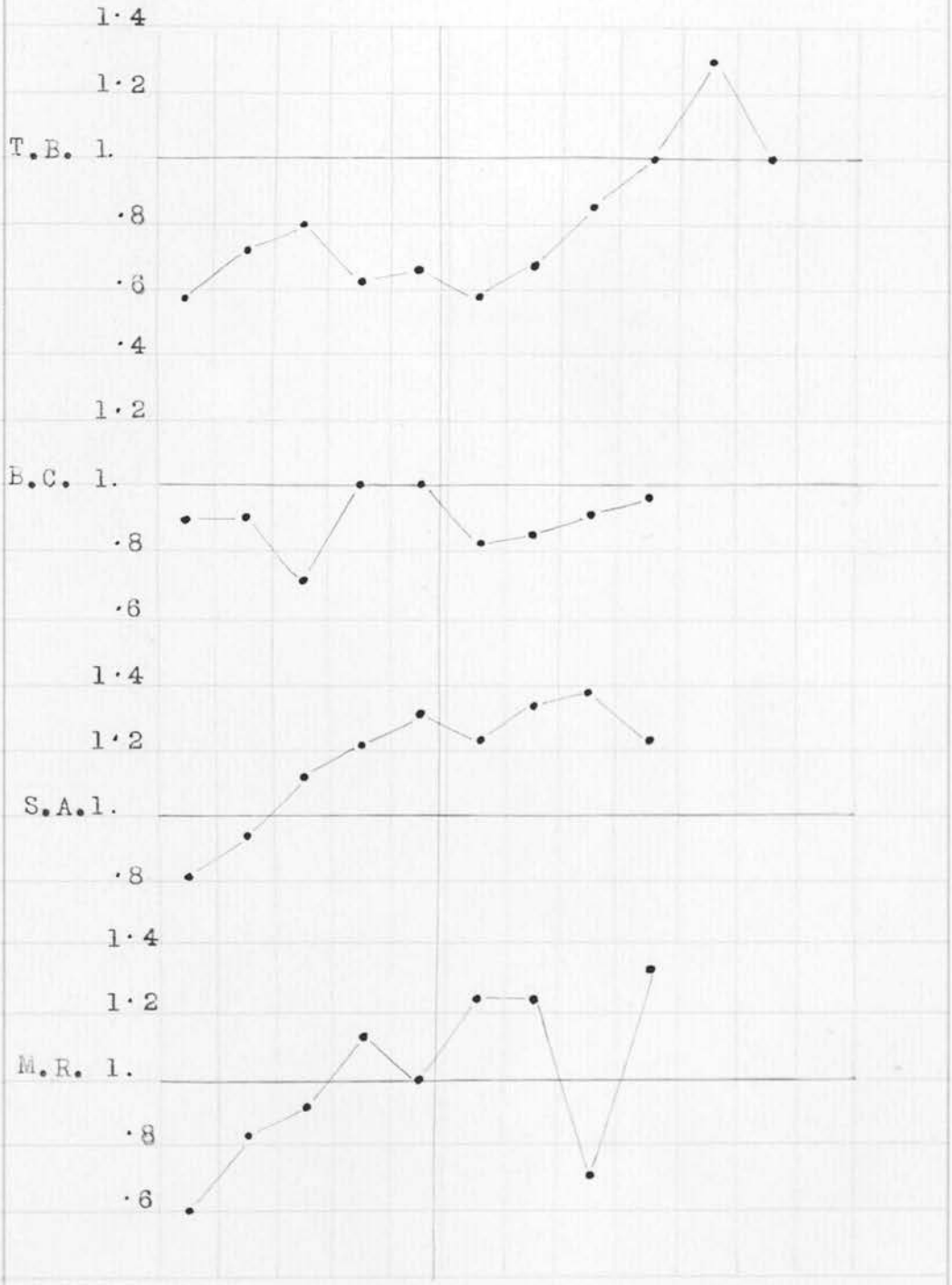
CHARTS SHOWING DAILY OPSONIC INDICES TO THE TUBERCLE BACILLUS, BACILLUS COLI COMMUNIS, STAPHYLOCOCCUS AUREUS & MICROCOCCUS RHEUMATICUS BEFORE & AFTER THE INJECTION OF 1/500 mgr.T.R.

CONTROL CASE C.



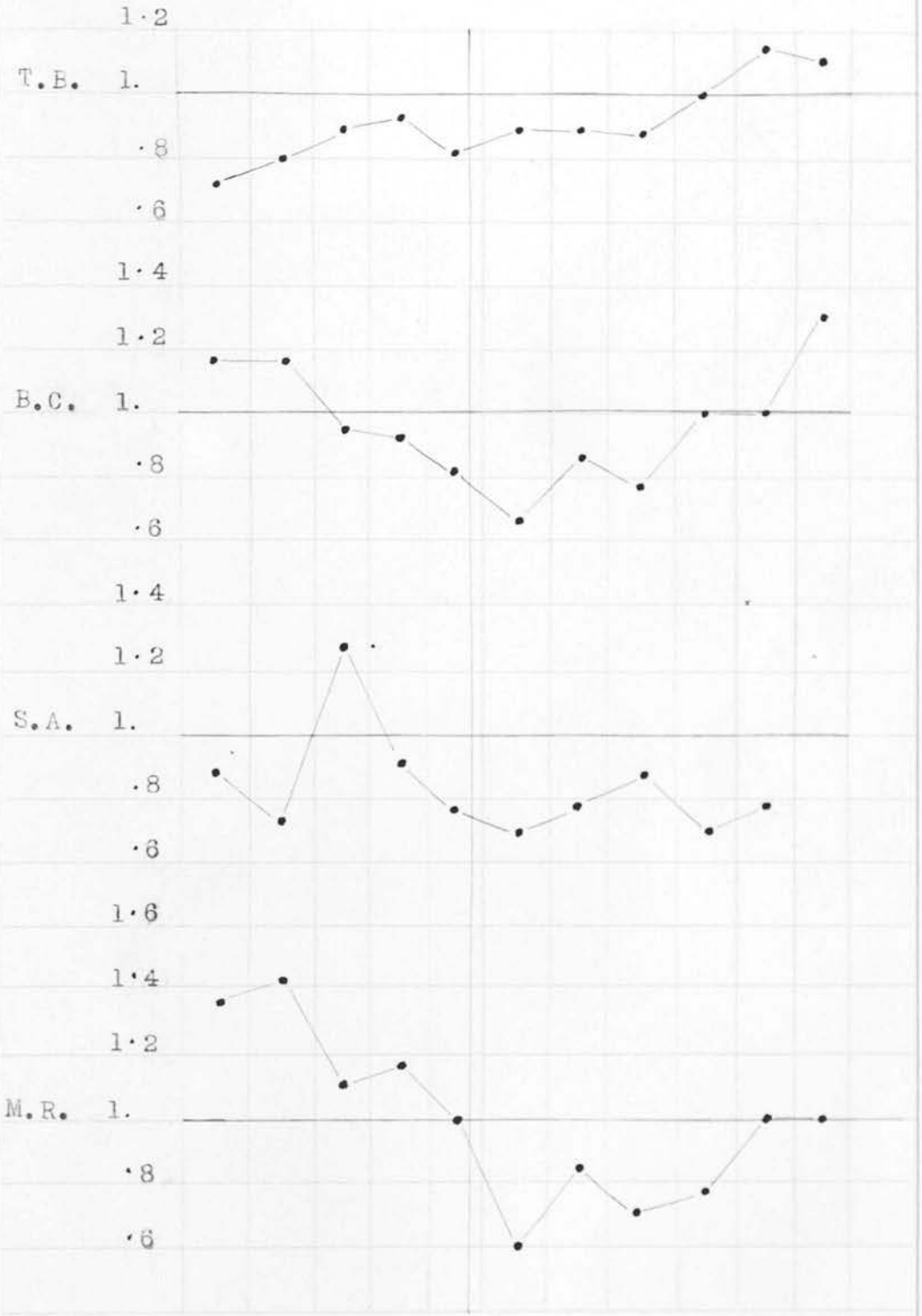
CHARTS SHOWING DAILY OPSONIC INDICES TO THE TUBERCLE BACILLUS, BACILLUS COLI COMMUNIS STAPHYLOCOCCUS AUREUS & MICROCOCCUS RHEUMATICUS BEFORE & AFTER THE INJECTION OF 1/500 mgr. T.R.

C A S E . 3.



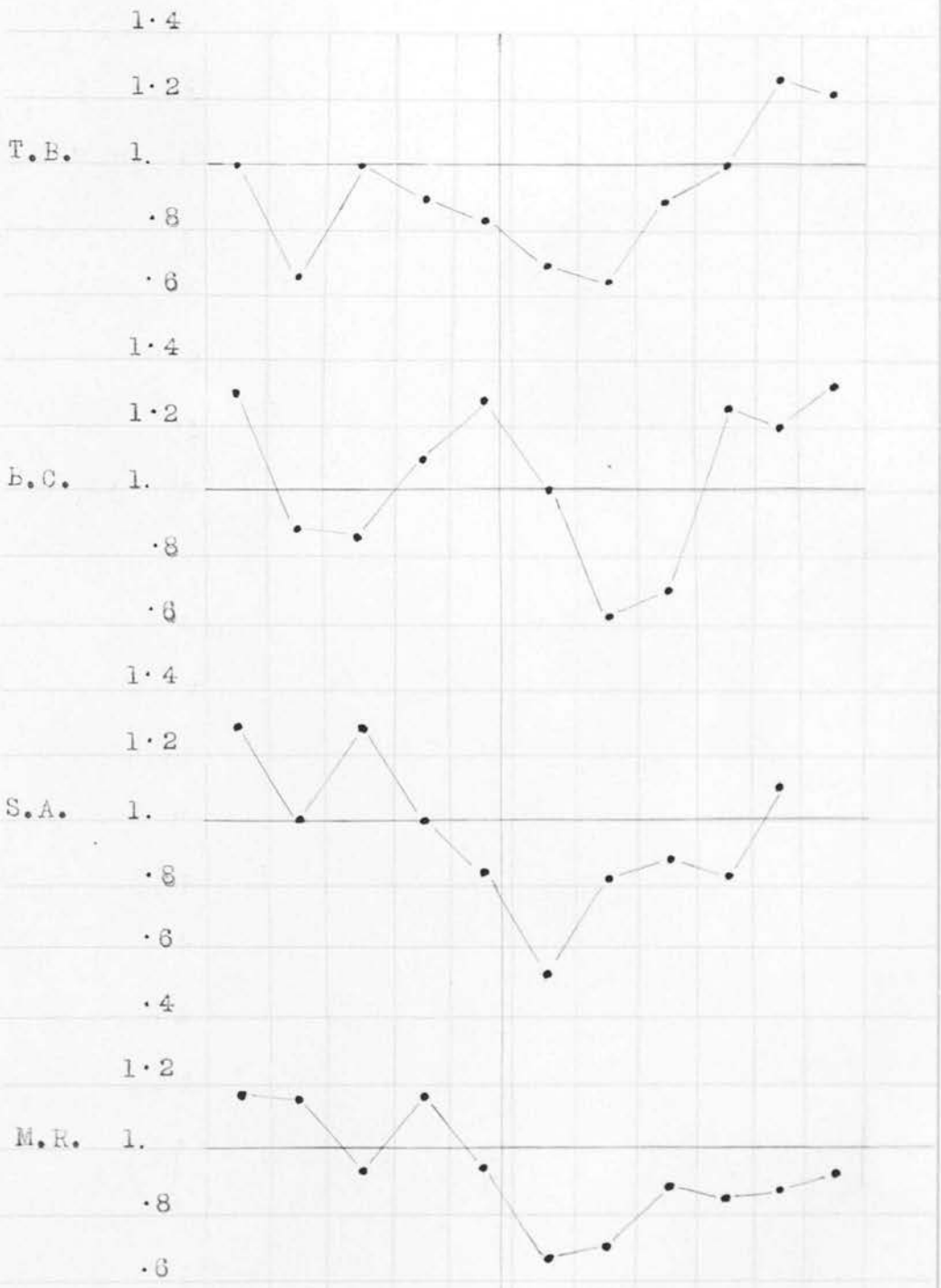
CHARTS SHOWING DAILY OPSONIC INDICES TO THE TUBERCLE BACILLUS, BACILLUS COLI COMMUNIS STAPHYLOCOCCUS AUREUS & MICROCOCCUS RHEUMATICUS BEFORE & AFTER THE INJECTION OF 1/500 mgr.T.R.

CASE 8.



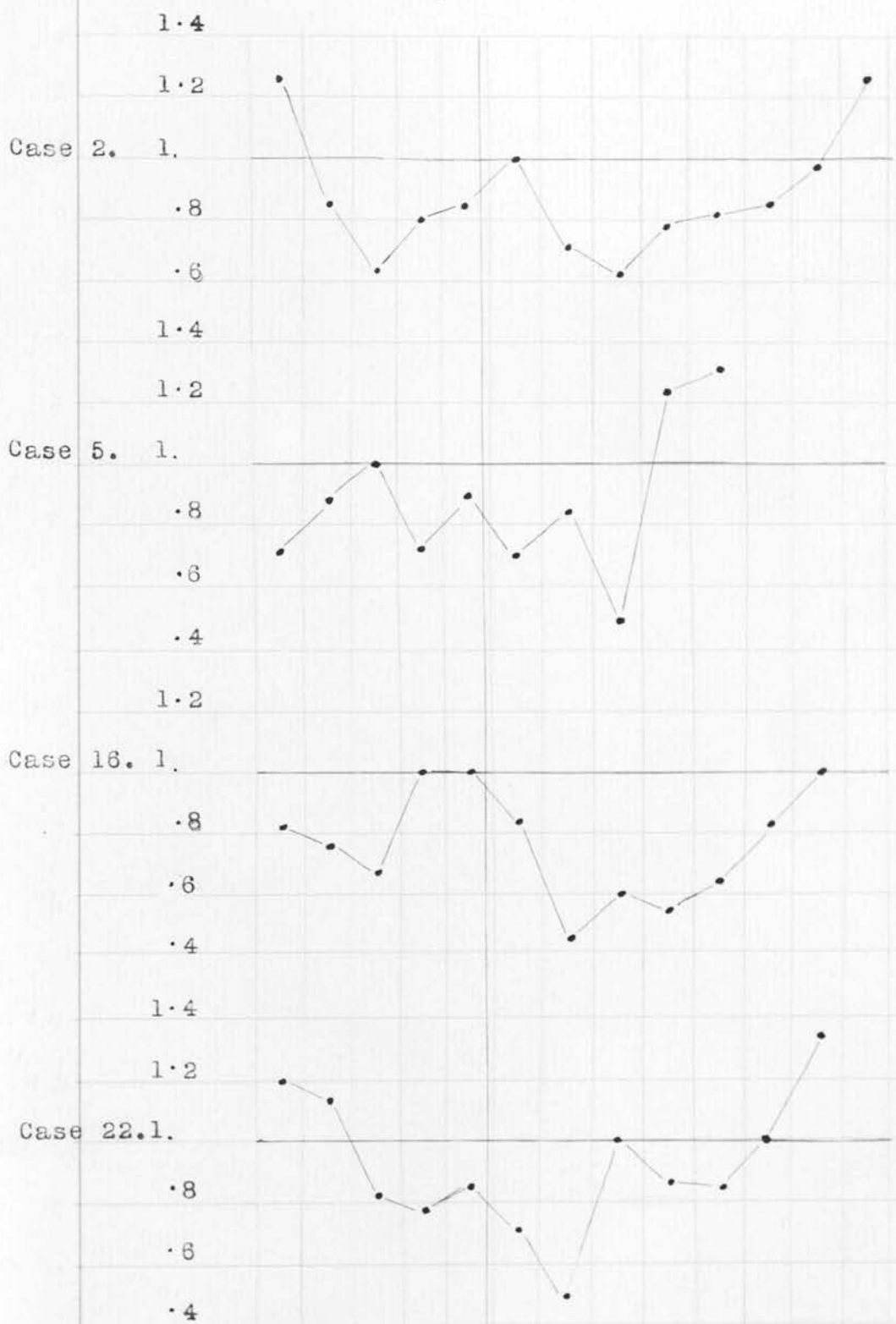
CHARTS SHOWING DAILY OPSONIC INDICES TO THE TUBERCLE BACILLUS, BACILLUS COLI COMMUNIS STAPHYLOCOCCUS AUREUS & MICROCOCCUS RHEUMATICUS BEFORE & AFTER THE INJECTION OF 1/500 mgr. T.R.

C A S E 25.



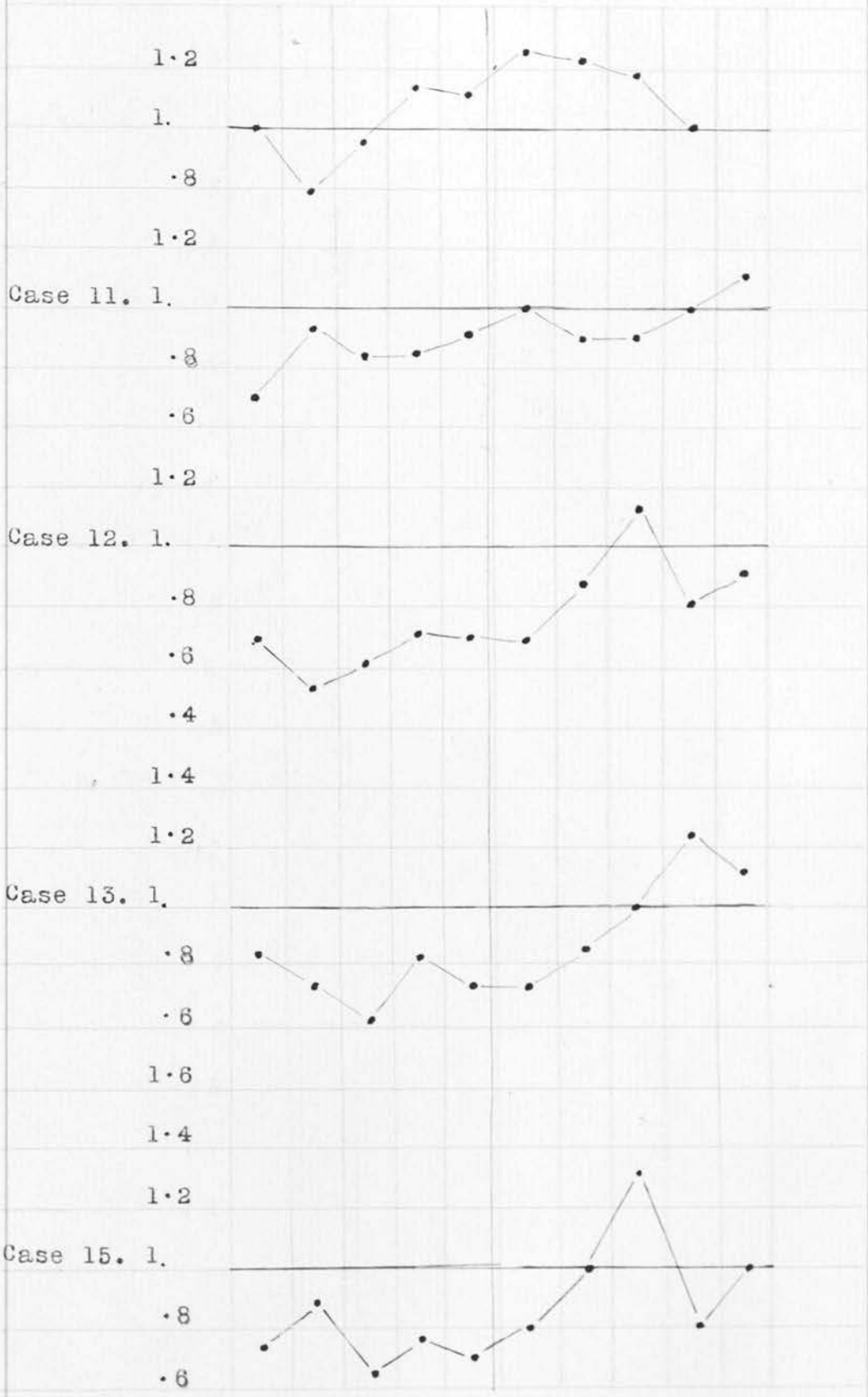
INJECTED.

CHARTS SHOWING DAILY TUBERCULO-OPSONIC INDICES OF FOUR INSANE PATIENTS, _ BEFORE & AFTER THE INJECTION OF 1/500 mgr. T.R.

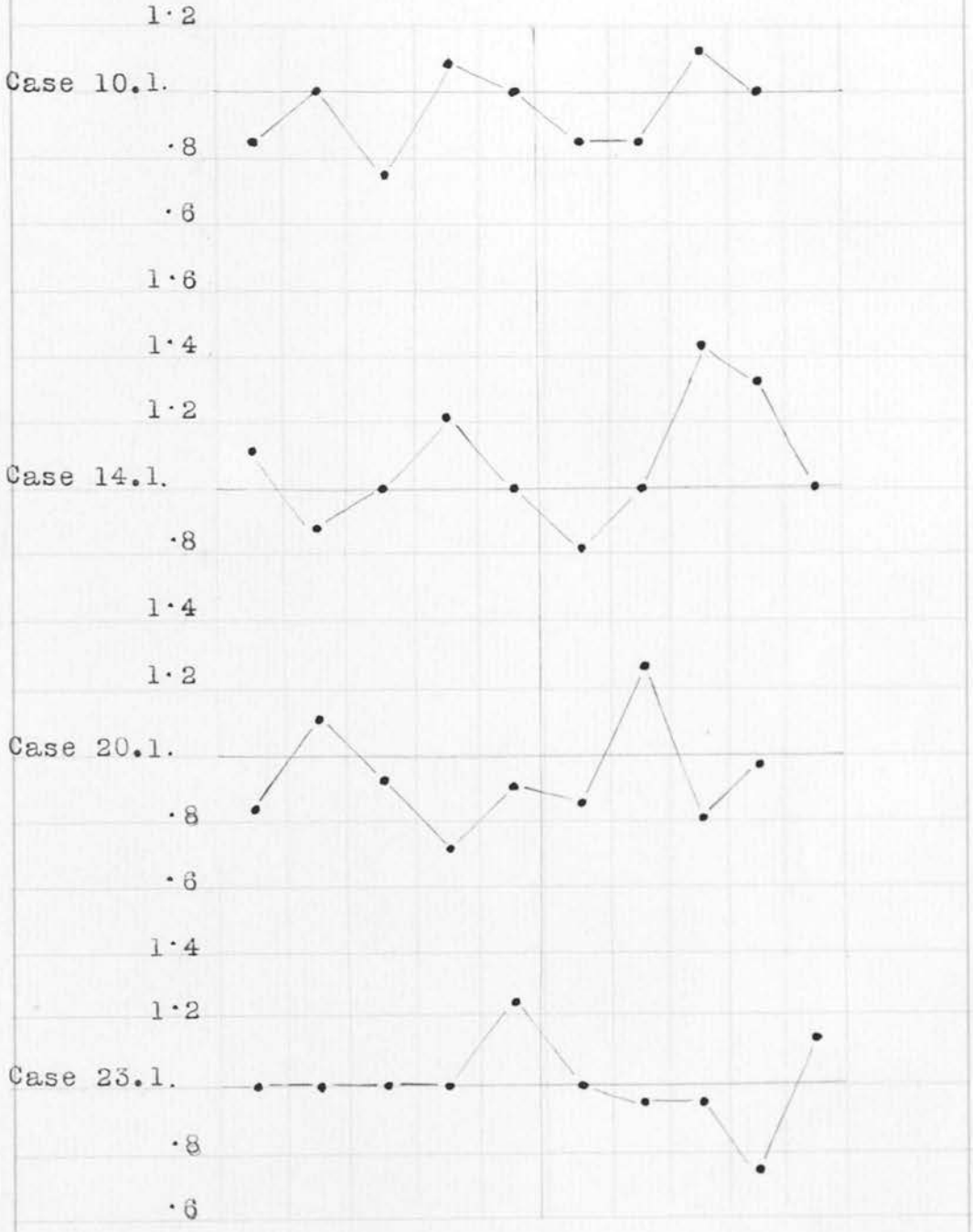


CHARTS SHOWING DAILY TUBERCULO-OPSONIC INDICES, BEFORE & AFTER THE INJECTION OF 1/750 mgr. T.R., OF CASES IN WHICH NO NEGATIVE PHASE RESULTED : -

CONTROL CASE E.



CHARTS SHOWING DAILY TUBERCULO-OPSONIC INDICES, BEFORE & AFTER THE INJECTION OF 1/750 mgr. T.R., OF CASES IN WHICH A NEGATIVE PHASE RESULTED:-



CHARTS SHOWING DAILY OPSONIC INDICES TO THE TUBERCLE BACILLUS, BACILLUS COLI COMMUNIS STAPHYLOCOCCUS AUREUS & MICROCOCCUS RHEUMATICUS BEFORE & AFTER THE INJECTION OF 1/750 mgr. T.R.

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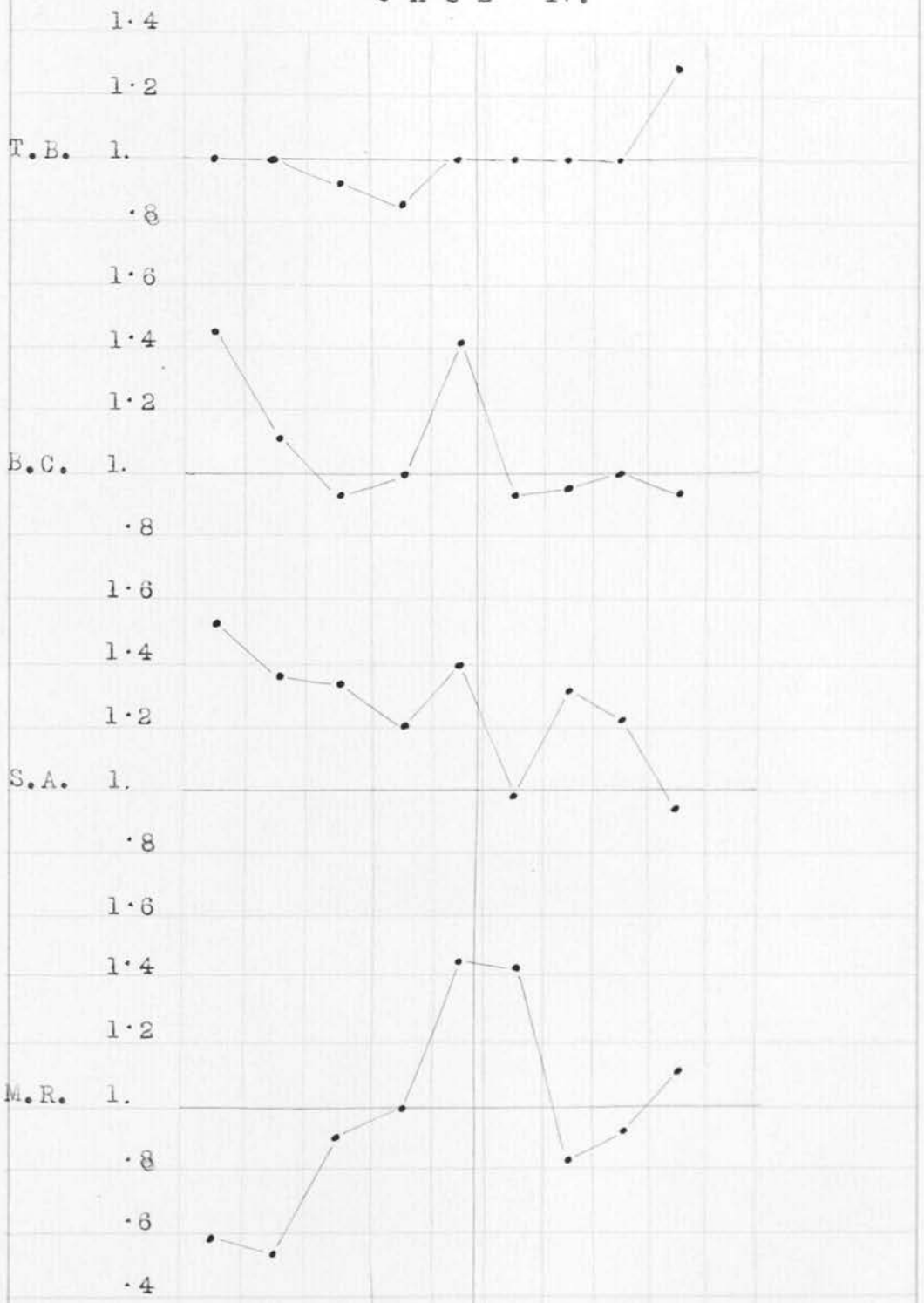
C A S E 17.



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